Planning and Environmental Consultants

Environmental Impact Assessment Report

Proposed Cahermurphy Two Wind Farm, Co. Clare

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 Mid Clare Renewable Energy Windfarm Ltd, who intends to apply to Clare County Council for planning permission to construct a renewable energy development and all associated infrastructure in the townland of Cahermurphy and adjacent townlands, in Co. Clare.

The townlands in which the proposed development is located are listed in Table 1.

Table 1 Townlands within which the Proposed Development is Located

Development Works	Townland
Wind turbines and access roads, Substation, Construction Compound, Borrow pits, Met mast, forestry felling and all associated site development works.	Cahermurphy, Knocknahila More South, Carrownagry South and Caheraghacullin.
Grid Connection Route	Cahermurphy, Drummin, Doolough, Carrownagry South, Glenmore and Booltiagh.

This EIAR complies with the EIA Directive 2011/92/EU as amended by Directive 2014/52/EU. The Environmental Impact Assessment (EIA) of the proposed project will be undertaken by Clare County Council, as the competent authority.

Applicant

The applicant for the proposed development is Mid Clare Renewable Energy Windfarm Ltd (MCRE). Coillte and MCRE are proposing to co-develop this project, also known as the Cahermurphy Two wind farm project. Mid Clare Renewable Energy Windfarm Ltd (MCRE) is 100 percent Irish owned and is locally owned by Co. Clare based shareholders.

Coillte have been involved in the development of 4 operating wind farms including Raheenleagh (Wicklow), Sliabh Bawn (Roscommon), Cloosh (Galway) and Castlepook (Cork) which have a combined total capacity of over 300 megawatts (MW). This project is part of a wider Coillte ambition to support the delivery of a further 1 GW of renewable energy and therefore make a significant contribution to the ambitions outlined in the All of Government Climate Action Plan 2019.

Brief Description of the Proposed Development

The proposed development comprises the construction of 10 No. wind turbines and all associated works. The proposed turbines will have a blade tip height of up to 170 metres above the top of the foundation. The full description of the proposed development, is as follows:

i. *Construction of up to 10 No. wind turbines with a maximum overall blade tip height of up to 170 metres and associated hard stand areas;*
ii. *1 no. permanent Meteorological Mast with a maximum height of up to 100 metres;*
iii. *1no. 38kV permanent electrical substation which will be constructed at one of two possible locations on site: either Option A in Carrownagry South townland or Option B in Cahermurphy townland. The electrical substation will have 1 no. control building*

with welfare facilities, all associated electrical plant and equipment, security fencing, all associated underground cabling, waste water holding tank and all ancillary works;

iv. *All associated underground electrical and communications cabling connecting the turbines to the proposed on-site substation;*
v. *All works associated with the connection of the proposed wind farm to the national electricity grid via an underground cable to the existing Booltiagh 110kV substation;*
vi. *Upgrade of existing tracks, roads and provision of new site access roads and hardstand areas;*
vii. *Junction access road works;*
viii. *2 no. borrow pits;*
ix. *1 no. temporary construction compound;*
x. *Site Drainage;*
xi. *Forestry Felling to facilitate construction and operation of the proposed development; and*
xii. *All associated and ancillary site development works.*

This application is seeking a ten-year permission and 30 year operational life from the date of commissioning of the renewable energy development.

The layout of the proposed development has been led by consideration of constraints and facilitators, thereby avoiding the environmentally sensitive parts of the site. The roads layout for the proposed development maximises the use of the existing onsite access roads and tracks where possible, with approximately 6.6 kilometres of existing roadway/ tracks requiring upgrading and approximately 4.9 kilometres of new access road to be constructed.

The planning application for the proposed wind farm includes connection to the national electricity grid. The planning application includes 2 No. substations; however, only one substation will ultimately be constructed and is being applied for as part of this application.

All elements of the overall project, including wind farm, grid connection, forestry felling, as well as the replanting have been assessed as part of this EIAR.

Modern wind turbine generators typically have an output of between 3.0 and 4.8MW. For the purposes of this EIAR it is assumed that the wind turbine model installed as part of the proposed renewable energy development will have a rated output of 4.8MW. Therefore, based on 10 no. wind turbines, the proposed wind turbines will have a combined output of approximately 48MW.

Need for the Proposed Development

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 to its 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 2.2.3 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 Cahermurphy Two 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 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 change may have on Ireland's 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 further policy support for increased wind energy. Further information relating to the Climate Action Plan can be found in Chapter 2, Section 2.3.4.

Section 2.2 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 2.3 addresses climate change, including Ireland's current status with regard to meeting greenhouse gas emission reduction targets.

Economic Benefits

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 Clare County Council, will be redirected to the provision of public services within Co. Clare. 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 up to 72 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.

Should the proposed development receive planning permission, there are substantial opportunities available for the local area in the form of Community Benefit Funds. Based on the current proposal, a Community Benefit Fund in the region of €5.6 million will be made available over the lifetime of the project. The value of this fund will be directly proportional to the level of installed MWs 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 2-2 of this EIAR.

The proposed Renewable Energy Support Scheme (RESS) sets out that future renewable energy project proposals enable the possibility for local communities to invest in projects in a meaningful way as a means to directly gain from the financial dividends that a project can provide should it be consented, built and operated. In response to this MCRE & Coillte have been working hard with external agencies to develop workable models of Community Investment. As with the benefit fund, we aim to take this work into the community during 2020, to continue to explore this exciting possibility and see how best to embed its design within the community.

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, in this case Clare County Council.

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. *Shadow Flicker*
7. *Biodiversity*
8. *Ornithology*
9. *Land, Soils and Geology*
10. *Hydrology and Hydrogeology*
11. *Air and Climate*
12. *Noise and Vibration*
13. *Landscape and Visual*
14. *Archaeological and Cultural Heritage*
15. *Material Assets (including Traffic and Transport, Telecommunications and Aviation)*
16. *Interactions of the Foregoing*
17. *Schedule of Mitigation*

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

Background to the Proposed Development

This section of the EIAR presents policy information on Energy and Climate Change policy and targets, the strategic, regional, and local planning context for the proposed development, scoping and consultation, and the cumulative impact assessment process. A description of reasonable alternatives studied by the developer, relevant to the project including renewable energy technologies, turbine numbers, layout and design is included at Chapter 3 of this EIAR. This chapter provides an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment.

The policies and targets which have been put in place at the various levels of Government in relation to renewable energy and climate change illustrate the need for the proposed development to assist Ireland in meeting its national targets and European commitments in relation to climate change and decarbonisation. It is of note that latest projections have shown that Ireland is not set to meet its 2020 targets.

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.

Energy and Climate Change Targets

The overall share of renewables in primary energy in Ireland stood at 11.1% in 2018 which is up from the 2017 figure of 7.3%, 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 SEAI's Energy in Ireland 2018 Report, the contribution from renewables in 2005 was 2.8%, which as of 2017, has risen to 10.6% of the GFC. The SEAI's 2018 Report continues to note that 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% Renewable Energy Share (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 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 pace of 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.

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%.

It is estimated that 1 MW of wind capacity can provide enough electricity to supply approximately 730 homes. EirGrid in their *'Annual Renewable Energy Constraint & Curtailment Report 2017'* (June 2018) stated that the amount of wind energy installed in the island of Ireland at the end of 2017 had reached 3,311 Megawatts (MW). More recently, 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 Capacity Statement also notes 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. In this context, the importance of wind energy becomes more apparent as it is estimated that 1 MW of wind capacity can provide enough electricity to supply approximately 650 homes.

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".*

It is noted that the full impact of the demand from data centres may be underestimated in the EirGrid Generation Capacity Statement as it is understood that only the data centres with signed connection agreements have been considered in the report. There are other data centre projects which have made connection enquiries with EirGrid estimated at more than 1,000 MVA, that are in the planning process and well advanced however they have not been included in this demand forecast. 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.

Local Policy

The site of the proposed development is entirely within the administrative area of Clare County Council. As such the extant Clare County Development Plan 2017-2023 (as varied) is relevant.

Clare County Development Plan 2017-2023 (as varied)

In relation to energy, the Clare County Development Plan 2017 – 2023 ('CDP') recognises that an attractive environment for industry and therefore investment depends on the areas ability to deliver *"a competitive and uninterrupted energy supply."* A strategic plan-led approach has been employed in the CDP via the Clare Renewable Energy Strategy ('RES') in relation to renewable energy production. The Development Plan also includes a dedicated Wind Energy Strategy ('WES'). Both are presented in the context of what is a supportive overarching policy framework within the Development Plan.

The Plan is clear regarding the importance of wind energy in the Plan area. It states that the county "*has one of the best wind resources in the world – almost the entire county has either an excellent or very good wind energy resource.*" It also recognises however that wind energy development must be balanced against potential impacts on landscape, ecology and amenities of local communities.

Volume 5 of the Development Plan contains the Clare Wind Energy Strategy ('WES'). The Strategy (CWES) divides County Clare into four areas with regard to their capacity to accommodate wind energy developments on the basis of the County Landscape Character Assessment. The majority of the proposed development site is situated within an area designated as a '**Strategic Area'** for Wind Farm Development. One turbine falls within an area designated as '**Acceptable in Principle'**.

The WES defines these areas as follows:

1. Strategic Areas (WES Eight): "*These key areas are considered to be eminently suitable for wind farm development and are of strategic importance because of;*
    - *Good / excellent wind resources Access to grid*
    - *Distance from properties and*
    - *Outside any Natura 2000 sites Projects within these areas must:*
    - *Demonstrate conformity with existing and approved wind farms to avoid visual clutter. Be designed and developed in line with the Wind Energy Development Guidelines, Guidelines for Planning Authorities (DoEHLG, 2006) in terms of siting, layout and environmental studies.*
    - *Provide a Habitats Directive Assessment under Article 6 of the Habitat Regulations if the site is located in close proximity to a Special Area of Conservation or Special Protection Area.*
    - *Be developed in a comprehensive manner avoiding the piecemeal development of the areas designated as 'strategic'.*

    Target wind energy generation from strategic areas is 400MW"

2. Acceptable in Principle (WES 9) : "*These areas are considered suitable for wind farm development because of:*
    - *Sufficient wind speeds,*
    - *Access to grid network, and*
    - *Established patterns of inquiries.*

    Projects within these areas must:
    - *Demonstrate conformity with existing and approved wind farms to avoid visual clutter. Designed and developed in line with the Planning Guidelines in terms of siting, layout and environmental studies.*
    - *Provide a Habitats Directive Assessment under Article 6 of the Habitat Regulations if situated in proximity to a Special Area of Conservation or Special Protection Area will require. [sic]*

    Target wind energy generation from Acceptable in Principle areas is 150 MW"

As discussed in detail in various chapters of this EIAR the location of the proposed development is considered acceptable under the terms of WES 8 and 9, as noted above.

The RES aims to, in conjunction with the Development Plan, *"position the County as the national leader in renewable energy generation, supporting energy efficiency and conservation, with an accessible modern telecommunications infrastructure, achieving balanced social and economic development and assisting Ireland's Green Energy target.*"

The RES notes that "*energy needs in County Clare are expected to rise by 2020..."* This is balanced against a recognition that "*the County has considerable capacity to produce energy from renewable and indigenous resources.*" Policy RES 2.1 of the Strategy is that "*it is an objective of Clare County Council to meet the County's energy needs from 100% indigenous renewable energy sources.*"

The proposed development will directly assist in meeting the areas energy needs as noted in the Plan should it be consented.

Wind Energy Development Guidelines

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 Wind Energy Development Guidelines (December 2019). A consultation process in relation to the 2019 document concluded on the 19th of February 2020.

At time of writing, the Draft Guidelines have not yet been adopted, and the relevant guidelines remain those published in 2006. Notwithstanding this, however, due to the timelines associated with the planning process for renewable energy projects, it is possible that a version of the draft guidelines may be finalised during the consideration period for the current proposed development. The EIAR is cognisant of the Draft Revised Wind Energy Development Guidelines. To this end it is anticipated that the proposed Wind Farm will be capable of adhering to the relevant noise and shadow flicker standards and is in accordance with the setback requirements.

Planning History

The relevant planning history of the proposed development site, the planning applications in the vicinity of the site along with other wind energy applications within the wider area are set out at Section 2.5 of this EIAR.

Scoping and Consultation

A comprehensive scoping and consultation exercise was undertaken during the preparation of this EIAR. A scoping report, providing details of the application site and the proposed development, was prepared by MKO and circulated in June 2019. MKO requested the comments from relevant personnel/bodies in their respective capacities as consultees with regards to the EIAR process. Details of that scoping progress can be found at Section 2.6 of this EIAR.

Pre-application consultations were also held with Clare County Council where the proposed development was introduced and the following items discussed:

- Site Selection
  - Development Plan provisions
  - Site Constraints
- Development Description, Design & Layout
  - Iterative design process
  - Discussion of Layout
- Planning Application Approach
  - EIA Requirements
  - Councils Scoping Response
- Environmental Impact Assessment Report (EIAR)
  - Introduction, Background, Alternatives, Description
  - Population and Human Health, including Shadow Flicker
  - Biodiversity, including Flora & Fauna and Ornithology
  - Land, Soil, Water, Air & Climate
  - Noise
  - Landscape
  - Cultural Heritage, Material Assets (incl. Roads) and Interactions
- Community Engagement
- Cumulative Projects
  - Wind farm applications in vicinity and their status

The Applicant and Coillte's Renewable Energy team have undertaken community engagement, including meeting with many people living within 2km of the proposed wind farm. While public information events would typically feature as part of the overall community engagement process, the impacts of the Covid-19 pandemic and associated restrictions have meant that such engagement requires to be undertaken in a socially distant manner giving utmost regard for public health.

As such, information was distributed in leaflet form to inform of the project proposals, and seek feedback.

The information circulated discussed the need for onshore wind as part of the wider energy mix; the subject site and associated selection process; detail of the proposed development; and community benefits arising.

The 'Next Steps' section of the information leaflet noted that the application was in preparation and that once lodged, the period for public comments would be open.

Postal, telephone and email contacts are provided in the leaflet, as well as a direct link to the dedicated project website, www.cahermurphy2windfarm.ie.

Consideration of Reasonable Alternatives

This chapter of the EIAR includes a description of the reasonable alternatives studied by the developer which are relevant to the project and its specific characteristics and provides an indication of the main reasons for the option chosen, taking into account the environmental effects. The consideration of alternatives includes alternative design, technology, layout, 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, is also included.

Constraints mapping and a Landscape Capacity Assessment (LCA) was carried out at the preliminary stage of the project. The study examined three areas within the Cahermurphy landscape (Area A, B and C) with the view to accommodate a medium to large scale wind farm. Constraints mapping was initially carried out for the three areas. Following the initial constraints study, only two areas were considered for assessment in the LCA. The study looked at a 10 no. turbine layout in Area A and a 4 no. turbine layout in Area B. The findings from the study indicated that the spatial extent of all 14 no. turbines was deemed acceptable within the landscape setting and due to the distance between the proposed development and existing and permitted turbines cumulative effects arising were not considered to be significant. Notwithstanding the findings from the LCA, given the close proximity of the Hen Harrier territory at Doo Lough and the Cragnashingaun Bogs Natural Heritage Area, it was decided not to bring Area B forward for further consideration at this stage.

The design of the proposed development has been an informed and collaborative process from the outset, involving the designers, developers, engineers, environmental, hydrological and geotechnical, archaeological specialists and traffic consultants. The aim of the process being to reduce the potential for environmental effects while designing a project capable of being constructed and viable.

The final proposed turbine layout takes account of all site constraints and the distances to be maintained between turbines and from houses, roads, etc. The layout is based on the results of all site investigations and baseline assessments that have been carried out during the EIAR process. As information regarding the site of the proposed development was compiled and assessed, the proposed layout has been revised and amended to take account of the physical constraints of the site and the requirement for buffer zones and other areas in which no turbines could be located.

It was decided at an early stage during the design of the proposed development that maximum possible use would be made of existing roadways and tracks where available to minimise the potential for impacts by using new roads. 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 not favourable, as it would create the potential for additional significant environmental effects to occur in relation to land, soils and geology (increased excavation and aggregate requirements), hydrology, and biodiversity (increased habitat loss).

The use of a single temporary construction compound was deemed preferable to the alternative of two smaller compounds for a number of reasons. Principally, there will be less disturbance to site ecology and residential receptors in the vicinity of the site. There will also be a reduced visual impact arising from the development.

One potential location was initially identified for the proposed on-site substation. However in order to provide flexibility to the electrical network provider, two on-site substation locations options have been assessed and included in the planning application. Only one substation will ultimately be constructed.

The proposed grid connection route was one of two grid connection routes considered at the outset of the design process of the proposed development. Landowner consents for a section of the proposed cable grid connection from the onsite substation to the existing Slievecallan substation were not available at the time of report writing and therefore the proposed grid connection to the existing Booltiagh substation was the most favoured option of the two options considered. In conclusion, whilst both options are viable from an environmental perspective, the Slievecallan option has slightly more watercourse crossings when compared to the Booltiagh option which would increase the potential for silt-laden runoff and hydrocarbons to enter receiving watercourses. There is also a slight increase in habitat loss for the Slievecallan option when compared to the Booltiagh option.

The proposed borrow pit location was selected due to the presence of competent or usable rock at an acceptable level below existing surface level. An alternative to using onsite borrow pits was the option of sourcing stone and hardcore materials from a licensed quarry in the vicinity. The movement of such material would result in a significant increase in construction traffic and heavy loads and was therefore considered the least preferable option.

The alternatives considered for the port of entry of wind turbines into Ireland for the proposed development include Dublin Port and the Port of Galway. Dublin Port is the county's principal seaport catering for approximately two-thirds of Ireland's port traffic. 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 Shannon-Foynes), offer potential for the importing of turbine components and therefore are equally viable alternatives.

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, borrow pits, construction compound, internal roads layout and the main site entrance. Detailed site layout drawings of the Proposed Development are included in Appendix 4.1 to this EIAR.

The proposed wind turbines will have a tip height of up to 170 metres. Within this size envelope, various configurations of hub height, rotor diameter and ground to 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 170 metres. 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.

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 and a foundation area large enough to accommodate all modern turbine models has been assessed in this EIAR. 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 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 and to connect the wind turbines and associated infrastructure, approximately 4.9 kilometres of new access roads will need to be constructed including the upgrade 6.6km of existing access road.

It is proposed to develop 2 No. on-site borrow pits as part of the Proposed Development. It is proposed to obtain the majority of all rock and hardcore material that will be required during the construction of the proposed development from the on-site borrow pits.

It is proposed to construct one 38 kV electricity substation within the site, at one of two locations (Option A or B) as shown in Figure 4.1. The footprint of the proposed onsite electricity substation compound measures approximately 2,143 square metre.

One wind farm control building will be located within the substation compound. The wind farm control building 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 20 or 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 laid in trenches approximately 1.3 metres below the ground surface, along the sides of roadways within the windfarm site. A connection between the proposed development and the national electricity grid will be necessary to export electricity from the proposed wind farm. There are 2 No. substations options; however, only one substation will ultimately be constructed. The connection will originate at the proposed onsite substation and will be connected to the national grid via an underground grid connection cable which will connect into the existing Booltiagh 110kV substation. The grid connection cabling route is approximately 12.1 kilometres in length.

One permanent meteorological mast is proposed as part of the wind farm development. The meteorological mast will be equipped with wind monitoring equipment at various heights. The mast will be a slender free-standing structure up to 100 metres in height.

One temporary construction compound is 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 249,714m^3 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 within the proposed borrow pits or alongside the access roads.

A total of 34.11 hectares of forestry will have to be permanently felled for the proposed development. This includes a total of 27.6 hectares within and around the footprint of the Proposed Development and 6.51 hectares along the grid connection route. The area of forestry that will be permanently felled for

the footprint of the turbines and the other infrastructure and turbine erection will be replaced or replanted on a hectare for hectare basis as a condition of any felling licence that might be issued in respect of the proposed wind farm. This can occur anywhere in the state subject to licence. Four forestry replacement sites have been identified for the purposes of assessment in this EIAR. These sites are located in Cavan, Clare, Galway and Roscommon and have all been granted technical approval for afforestation by the Forest Service.

A 'Hen harrier and Peatland Habitat Enhancement Plan' has also been prepared for the proposed development which identifies an area of 28.2 ha of forestry on which to restore peatland habitats and to provide additional habitat for bird species including hen harrier and other species. In addition, local landowners have been engaged in a programme to farm in a hen harrier friendly manner. An area of c. 30 hectares of farmland has been identified for enhancement measures. This area is located 1.5km from the traditional hen harrier territory to the south of Doo Lough.

It is proposed to access the site of the Proposed Development via an existing access track off the local road to the east of the site. This entrance will be widened to facilitate the delivery of the construction materials and turbine components. The proposed works will result in a permanent upgrade of this current site access from the local road, which will also form the entrance to the Proposed Development during the operational phase.

It is proposed that large wind turbine components will be delivered to the site of the proposed development, from Dublin Port or Galway Port, via the N68 National Secondary Road. From Ennis the turbines will be transported southwest along the N68 National Secondary Road before turning right on to the R484 Regional Road and transported northwest until they reach the village of Kilmihil. The turbines will pass straight through Kilmihil continuing on the R484 until it reaches Creegh. At Creegh, the turbines will turn right at the crossroad onto a local road passing Creegh North, Clooneenagh and Cahermurphy Hill after which it will take a sharp left onto a local road approaching the proposed wind farm development site from the south. The delivery route for general HGV construction traffic will follow a more direct route to the site via the local road network from the village of Kilmihil.

MCRE expects that for each megawatt hour (MWh) of electricity produced by the wind farm, the project will contribute €2 into a community fund for the RESS period i.e. first 15 years of operation and €1 per MWh for the remaining lifetime of the wind farm. If this commitment is improved upon in upcoming Government Policy it will be adjusted accordingly .If this project is constructed as currently designed it is estimated that a total of approximately €5.6 million will be available in the local area for community funding over the lifetime of the project.

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. The proposed development's drainage design 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 12 to 18 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: 10 months, 2) electrical works: 6 months, and 3) turbine erection and commissioning: 8 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. The onsite substation will remain in place as it will be under the ownership of the ESB and will form a permanent part of the national electricity grid.

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, indirect or cumulative impacts arising from the construction and operation of a development. The key issues examined in this section of the EIAR relate to population and human health and incorporate population statistics, employment and economic activity, land-use, residential amenity (shadow flicker, noise, visuals and telecommunications), community facilities and services, tourism, property values, accidents/natural disasters, health and safety and other environmental hazards such as water contamination, air pollution, traffic and flooding.

The proposed wind farm site is located approximately 5 kilometres to the north of Kilmihil and 25 kilometres southwest of Ennis, Co. Clare. The majority of amenities and community facilities, including GAA and other sports clubs, youth clubs and recreational areas available in the area are located in the centres of settlement throughout the wider area. Retail and personal services within the vicinity are provided in the larger settlements such as Kilrush and Ennis. There are no key identified tourist attractions pertaining specifically to the site of the proposed development itself.

The Study Area for the Population and Human Health assessment was defined by the 4 No. District Electoral Division (DED)s within and adjacent to the development site. The population of the DEDs within the Study Area decreased by 6.5% between 2011 and 2016, falling from 1,193 to 1,116 persons, respectively, with the rate of population change unevenly distributed between the DEDs. The highest levels of employment within the Study Area were recorded in the Farmer category. The levels of employment within the Employer/Manager, Higher Professional, Lower Professional and Non-manual in the Study Area were lower than those recorded for the State and County Clare, while those recorded within the Unskilled, Own Account, Farmer and Agricultural Worker were higher.

As stated above, up to 72 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. The provision of underground electric cables 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.

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 and operational 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.

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 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 health in the surrounding 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 or local scale.

Shadow Flicker

Shadow flicker is an effect that occurs when rotating wind turbine blades cast shadows over a window in a nearby property. Shadow flicker 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. There is a total of 100 No. properties including occupied, unoccupied/derelict, within a distance of 10 rotor diameters (assumed at 1,400 metres) from the proposed 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 28.3% was applied. Of the 100 No. properties modelled, it is predicted that 54 No. properties may experience daily shadow flicker in excess of the DoEHLG guideline threshold of 30 minutes per day. This prediction is assuming worst-case conditions (i.e. 100% sunshine on all days where the shadow of the turbines passes over a house, wind blowing in the correct direction, no screening present, etc.) and in the absence of any turbine control measures. When the regional sunshine average (i.e. the mean amount of sunshine hours throughout the year) of 28.3% is applied, only 5 no. properties experience shadow flicker in excess of the 30 minutes per day.

Where shadow flicker exceedances are experienced, suitable mitigation measures as outlined in Chapter 6 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 1km study area. The same mitigation strategies also demonstrate that the proposed Cahermurphy Two 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.

Biodiversity

The habitats, flora and fauna of the site including species and habitats protected under Habitats Directive (92/43/EEC) were assessed by means of a desk study of literature pertinent to the site and

surrounding area, and field surveys including a survey of habitats and flora and walkover faunal surveys along with general observation work.

The Proposed Development site is located 5 kilometres to the north of Kilmihil and 25 kilometres southwest of Ennis, Co. Clare. It is proposed to connect the development to the national electricity network via a 38kV underground cable which will connect the proposed onsite substation to the existing Booltiagh substation, located approximately 7 kilometres to the southeast of the site. Current land-use on the subject site comprises coniferous forestry, agriculture and turbary.

Dedicated ecological surveys of the proposed development were undertaken on the 8th and 9th May 2019, 19th July 2019, 27th August 2019, 4th September 2019 and 11th October 2019 and 14th of May 2020. Habitats within the site were classified based on vegetation present and management history. During the multi-disciplinary ecological walkover surveys, the potential for the study area to support protected birds, mammals, amphibians and additional fauna was assessed.

A total of thirteen habitats were recorded within the study area including Conifer Plantation (WD4), Wet grassland (GS4), Improved Agricultural grassland (GA1), Wet Heath (HH3) (peatland mosaic), Cutover bog (PB4) (peatland mosaic), Lowland blanket bog (PB3) (peatland mosaic), Scrub (WS1) Spoil and Bare Ground (ED2), Recolonising Bare Ground (ED3), Buildings and Artificial Surfaces (BL3), Mixed broadleaved woodland (WD1), Eroding/Upland Rivers (FW1) and Drainage Ditches (FW4). The proposed development is largely confined to areas of conifer plantation and agricultural grassland.

There are a number of watercourses recorded within the proposed development site that provide connectivity with the Creegh and Annageeragh rivers downstream. Dedicated surveys were carried out to identify any suitable habitat or potential for populations of Freshwater Pearl Mussel (Margaratifera margaratifera) downstream of the proposed development site. Four streams that run from the proposed development site were surveyed for potential to support Freshwater Pearl Mussel; Knocknahila Beg Stream, Lissyneillan Stream, Knocknahila More Stream and Clooneenagh Stream. None of these streams provided suitable habitat for the species and no Freshwater Pearl Mussel were recorded. A suite of best practice measures have been incorporated into the design of the proposed development to ensure there are no indirect impacts on any watercourses.

Dedicated surveys for marsh fritillary larval webs were undertaken on 27th August 2019 and 4th September 2019. No evidence of marsh fritillary was recorded within the proposed development site.

Third Schedule invasive species, Rhododendron (Rhododendron ponticum) was recorded along the proposed cable route. A site specific Invasive Species Management Plan has been prepared in relation to Rhododendron within the site.

The Proposed Development is located approximately 5.8km east of Carrowmore Point to Spanish Point and Islands SAC (001021) and Mid-Clare Coast SPA (004182) and 6.6km east of Carrowmore Dunes SAC (002250). The proposed grid connection route occurs adjacent to Cragnashingaun Bogs NHA in one location but is restricted to forestry track and will not impact on the adjacent peatland habitat. There are a number of watercourses which drain from the Proposed Development site that provide hydrological connectivity with the European sites downstream. Potential impacts in the form of surface water deterioration will be prevented by adherence to the mitigation described in Chapter 4 of the EIAR.

Effects upon European Sites are discussed within the Natura Impact Statement which accompanies this report. The NIS concluded that the subject development, by itself or in combination with other plans and projects, in light of best scientific knowledge in the field, will not adversely affect the integrity of any European sites.

Provided that the proposed development is constructed and operated in accordance with the design, best practice and mitigation that is described within this application, significant individual or cumulative effects on biodiversity are not anticipated at the international, national or county scales.

Ornithology

This chapter assesses the likely significant effects that the proposed development may have on bird species including species protected under the Birds Directive (2009/147/EC). Firstly, a brief description of the proposed development is provided. This is followed by a comprehensive description of the methodologies that were 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 information presented within this chapter. An analysis of the results is then provided, which discusses the ecological significance of the birds recorded within the study area. The potential effects of 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 identification of Key Ornithological Receptors and the assessment of effects followed a precautionary approach.

The potential for effects on designated sites is fully described in the Natura Impact Statement that accompanies this application. The findings presented in the NIS are that the proposed development, by itself or in combination with other plans and projects, in light of best scientific knowledge in the field, will not adversely affect the integrity of the relevant European sites and no reasonable scientific doubt remains as to the absence of such effects.

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, disturbance displacement, collision risk and cumulative effects have been assessed to be no greater than Long-term slight negative effect (EPA, 2017) and low effect significance (Percival, 2003), for all species with the exception of hen harrier.

A Habitat Enhancement Plan has been proposed for hen harrier and is fully described within the Chapter and accompanying Appendix 8-8. With the successful implementation of the enhancement plan, the predicted impacts on hen harrier 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 enhancement and 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 key ornithological receptors 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.

The geology of the Proposed Development site predominately comprises poorly draining soil or blanket peat overlying mineral subsoil which in turn is underlain by sandstone and siltstone bedrock.

Peat depths at the wind farm site ranged from 0 to 2.7m with an average of 0.7m. Over 95 percent of peat depth probes recorded peat depths of less than 3.0m. The peat depths recorded at the turbine locations varied from 0.25 to 2.6m with an average depth of 0.7m.

With respect to the existing and proposed access roads, peat thicknesses are typically less than 1.5m with localised depths of 2.5m.

The average peat depth across the grid connection cable route is 1m with 42% being less than 0.5m and 65% being less than 1m.

Construction of the wind farm site and grid connection infrastructure will require the removal of peat, soil and rock to competent foundation. Excavation of bedrock from 2 no. on-site borrow pits will provide material for access road, turbine bases and general hard-standing construction. Removal of soil, peat and bedrock represents a direct impact on the geology of the proposed development site which is considered to be an acceptable part of economic progression and development.

During the construction phase sources of contaminants (such as oil based substances or other hazardous chemicals) will not be stored at the site except where this is done within safely bunded areas that safely contain all spillages and prevent the migration of contaminants into soil, peat and bedrock. Refueling will be done with a double skinned bowser with spill kits on the ready in case of accidental spillages. The use of hydrocarbons in plant and vehicles is a standard risk associated with all construction sites. Proven and effective measures to mitigate the risk of spills and leaks have been proposed and will break the pathway between the potential source and the receptor.. Drainage and erosion prevention measures will be put in place at all works locations.

The peat stability assessment undertaken at the site shows that the wind farm site and grid connection cable route have a low risk of slope failure or mass movements. Peat removed during the excavation works will be deposited in the on-site borrow pits and also used for reinstatement and landscaping works around the site. This will reduce the requirement for stock piling and potential slope failure and erosion. The handling and management of peat will be undertaken in accordance with the Peat & Spoil Management Plan which is included in Appendix 4-2 of the EIAR.

If the mitigation measures presented in the EIAR are put in place no significant residual impacts on the land, soils and geological environmental are anticipated.

The land and soils impact assessment undertaken in this EIAR outlines that significant effects are unlikely due to the direct, localized nature of the construction works. Therefore, no cumulative effects will occur with other local developments. The proposed nearby hen harrier enhancement lands, which form part of the overall project development, will have no significant effect on land, soils and geology.

The proposed forestry replanting lands are located in counties Roscommon, Clare, Galway and Cavan and underlain by different geological bedrock formations, and therefore are not likely to contribute to potential cumulative impacts with the Proposed Development site in terms of impacts on land, soils and geology.

Hydrology and Hydrogeology

Hydro-Environmental Services (HES) was engaged by MKO to undertake an assessment of the potential direct, indirect and cumulative effects of the proposed Cahermurphy Two Wind Farm development on water aspects (hydrology and hydrogeology) of the receiving environment.

On a local scale the northern section of the wind farm site (3 no. of 10 turbines) is located within the Annageeragh River catchment while the southern section of the site (7 no. of 10 turbines) is located within the Creegh River catchment. The Annageeragh River originates from Doo Lough which is located approximately 2.6km to the northeast of the wind farm site. There is no wind farm site drainage into Doo Lough.

The majority of grid connection cable route is located in the Annageeragh River catchment (~180m of the grid near the Booltiagh WF Substation extends into the Doonbeg River catchment. Within the

Annageeragh River catchment, approximately 6.5km of the grid route drains into Doo Lough. The proposed hen harrier enhancement lands, which form part of the overall project, are also located in the Annageeragh River catchment.

The bedrock underlying the proposed development site is classified as locally important in terms well water yields. The bedrock has little or no open cracks which means groundwater movement within the aquifer is localised. Groundwater at the site can be classed as sensitive in terms of potential impacts from the proposed development. However, the majority of the bedrock is covered in peat which acts as a protective cover to groundwater quality. The low potential for pollutant travel within the bedrock groundwater makes surface water bodies such as streams more vulnerable to pollution than groundwater at this site. There will be no impact on private wells as a result of the development.

Ecologically protected sites downstream of the site include the Mid-Clare Coast SPA (Site Code 004182), Carrowmore Point to Spanish Point and Islands cSAC (Site Code 001021) and White Strand/Carrowmore Marsh (Site Code 001007). From a surface water quality perspective there will be no impact on these marine designated sites.

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 risk to groundwater at the site would be from hydrocarbon spillage and leakages at the borrow pits. These are common potential impacts to all construction sites (such as road works and industrial sites). These potential contamination sources are to be carefully managed at the site during the construction and operational phases of the development and measures are proposed within the EIAR to deal with these potential minor impacts.

Two methods will be employed to control drainage water within the site during construction, thereby protecting downstream surface water quality and aquatic habitats. 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, to allow settlement and cleaning prior to its release. During the construction phase all runoff will be treated to a high quality prior to being released. A self-imposed 50m stream buffer was used during the layout of the proposed wind farm development site, thereby avoiding sensitive hydrological features.

Other preventative measures also include fuel and concrete management and a waste management plan which is incorporated into the overall Construction and Environmental Management Plan included in Appendix 4-4 of this EIAR.

There will be no risk of increased flooding down-gradient of the site as a result of the proposed development due to these drainage measures. Impacts on water quality during the construction phase of the wind farm will be imperceptible to none. A surface water monitoring programme will be put in place during the construction phase.

During the operational phase drainage control measures will ensure that surface runoff from the developed areas of the site will continue to be of good quality and will therefore not impact on the quality of down-stream rivers and streams. The present drainage regime of the site will not be altered in any way. Impacts on water quality during the operational phase of the wind farm will be negligible to none.

In terms of potential cumulative hydrological impacts with other wind farm developments, the biggest risk is during the construction phase of the development as this is the phase when earthworks and excavations will be undertaken at the sites. However, within the Creegh River and the Annageeragh River catchments the vast majority of the other windfarm developments are either operational or currently being constructed, therefore construction phase impacts with the proposed Cahermurphy

Phase Two Wind Farm cannot occur if the development is permitted. No operational phase cumulative hydrological impacts are anticipated.

The forestry replanting lands are located in counties Roscommon, Clare, Galway and Cavan and in a different water catchment and therefore will not contribute to potential cumulative impacts with the proposed wind farm development site or grid connection.

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 Clean Air for Europe (CAFE) Directive (as amended) and the Fourth Daughter Directive. 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 4-4 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 linked to increased 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.

A methodology for calculation carbon losses was published in June 2008 by scientists at the University of Aberdeen and the Macauley Institute with support from the Rural and Environment Research and Analysis Directorate of the Scottish Government, Science Policy and Co-ordination Division. This methodology was refined and updated in 2011 based on feedback from users of the initial methodology and further research in the area. The web-based version of the carbon calculator, which supersedes the excel based versions of the tool, was released in 2016. The tool provides a transparent and easy to follow method for estimating the impacts of wind farms on the carbon dynamics of peatlands and 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 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 and forestry felling. The model also calculates the carbon savings associated with the proposed wind farm development.

In total, it is estimated that **1,941,113** tonnes of carbon dioxide will be displaced over the proposed thirty-year lifetime of the wind farm.

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 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 Cahermurphy Two Windfarm development.

The methodology adopted for assessing the noise impact of the wind energy development is based on the guidance in the document '*Wind Energy Development Guidelines for Planning Authorities'* published by the Department of Environment, Community and Local Government, which are based on the UK document ETSU-R-97 The Assessment and Rating of Noise from Wind Farms which describes a detailed method for deriving maximum values of wind turbine noise, when measured at an external location in the vicinity of a house. Maximum values, or limits, are primarily based on the background noise levels and how it varies with wind speed, in the absence of wind farm.

The background noise environment has been established through noise monitoring surveys undertaken at several noise sensitive locations (NSLs) 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). Prevailing noise levels are primarily attributable to wind noise in foliage, local road traffic noise and other agricultural and anthropogenic sources in the area.

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 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, noise associated with the construction phase is not expected to exceed the recommended limit values. The associated noise and vibration are not expected to cause any significant effects.

Based on detailed information on the site layout, turbine noise emission levels and turbine height, worst-case turbine noise levels have been predicted at NSLs for a range of operational wind speeds. The predicted noise levels associated with the proposed development will be within best practice noise limits recommended in Irish guidance, therefore it is not considered that a significant effect is associated with the 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 in the context of current national guidance.

Landscape and Visual

The site is on the western edge of an elevated plateaux of land over 100 metres in elevation and extending up to 261 metres (Ben Dash) and 391 metres (Slievecallan) in places that forms an area of upland in central West-Clare. The site is nine kilometres inland from the Atlantic coast, ten kilometres

south of the town of Miltown Malbay, 16 kilometres northeast of Kilrush and 12 kilometres east of the village of Doonbeg.

The majority of the proposed development site, and nine of the ten proposed wind turbines are situated within an area designated as a 'Strategic Area' for Wind Farm Development in the Clare Wind Energy Strategy. One turbine falls within an area designated as 'Acceptable in Principle'. The proposed site is largely located in the Sliabh Callan Uplands LCA (landscape character area), which is recognised as having an overall Medium to Low sensitivity to wind farm developments, in which "large" sized wind farms are deemed to be appropriate. Although a portion of the proposed site and two proposed turbines are located in the Malbay Coastal Farmland LCA, which is considered to have a higher overall sensitivity to wind farm developments, those two turbine locations are also classified as being 'Strategic Areas' for wind farm development in the Clare Wind Energy Strategy.

There are five scenic routes within the 20 km LVIA study area, with four (SR1, SR19, SR20, SR33) being coastal routes and the fifth inland (6.7 kilometres north of the site) but with an intended view towards the coast rather than towards the site.

Using the landscape types in the Wind Energy Planning Guidelines (DoEHLG, 2006), 'Transitional Marginal Landscapes' best describes the site and the LCA in which the site is located.

There are 12 operational, 2 permitted and one proposed wind farms that form part of the baseline landscape in the wider area and are considered in this LVIA. Wind energy developments are now an integral part of the west Clare landscape, having been guided and directed by a plan-led approach over the last decade. The proposed development is intended to further deliver on the targets that have been set by the Clare Wind Energy Strategy for the specific policy area and landscape character areas in which the proposed development site is located.

In the Do-Nothing scenario, the proposed development would not take place. The opportunity to harvest the wind resource at the site would be lost. Existing land uses would continue, which are forestry operations, including felling and replanting, agriculture and turbary. The existing wind farm developments in the general vicinity would continue to operate for their full permitted lives, including the adjacent four-turbine Cahermurphy wind farm, three of which are already operating. Other planning applications for wind farm developments are likely to continue to be brought forward for consideration in the wider area in years to come to meet the State's objective to decarbonise the economy and combat climate change, and until the stated acceptable capacities of the Clare Wind Energy Strategy's 'Strategic', 'Acceptable In Principle' and 'Open to Consideration' areas are delivered in full.

An assessment of the effects on landscape character was undertaken for the six Landscape Character Areas within the LVIA study area that were identified as having theoretical visibility of the proposed development. The significance of the landscape character effect was assessed as being Slight in three (LCA 17, LCA 19 and LCA21) with one Moderate (LCA 20), one Minor (LCA 18) and one Not Significant (LCA 3).

After identifying the cumulative baseline and cumulative status for each LCA, as assessment was made as to whether the additional proposed turbines would change the status of the individual LCAs. Although, it was found that the proposed development's turbines would add to the cumulative landscape status, they would not change the character of the individual LCAs in terms of wind energy and therefore the cumulative landscape effects are considered Slight. Wind turbines are already a common component of the west Clare landscape, as identified and intended by the Clare Wind Energy Strategy. The scale of the cumulative effect is also considered to be well within what was envisaged and considered to be acceptable under Clare Wind Energy Strategy which would have been subject to a full Strategic Environmental Assessment (SEA). The proposed development does not transform or redefine the baseline landscape character from any but a small handful of selected viewpoints.

The significance of the residual visual effect was not considered to be "Profound", "Very Significant" or "Significant" at any of the 13 viewpoint locations selected. All other viewpoints were assessed as resulting in Moderate (5), Slight (4), Not Significant (3) or Imperceptible (1) residual visual effects.

Of the 26 settlements identified in the study area, 16 were screened out in the 'Visual Receptor Preliminary Assessment', as no visibility of the proposed development could be established from the ZTV analysis. The classification of visual effect from the three closest settlements to the site (Kilmihil, Mullagh, Creegh) is Not Significant, and the visual effect from the other remaining settlements of Miltown Malbay, Spanish Point, Cranny, Doonbeg, Cappagh, Kilrush, and Moyasta is no greater than Not Significant and likely Imperceptible in a number of individual cases.

The addition of the proposed turbines will only result in turbines being visible from a very small additional area in the LVIA study area, compared to where the existing (operational), permitted or other proposed turbines will already be visible from. Therefore, the additional cumulative visibility of the proposed turbines is deemed to be Not Significant, that being an effect which causes noticeable changes in the character of the environment but without significant consequences. Overall, the cumulative visual impact can be described as a Long Term, Slight Cumulative Impact, given the amount of wind farm development that has already occurred and the limited numbers of additional turbines that will come into view as a result of the proposed development. The proposed development does not increase the spatial extent of the area from which any wind turbine will be visible. When viewed cumulatively with the other existing, permitted or proposed wind farms, the proposed development does not transform or redefine the baseline landscape character and is in keeping with current and emerging trends as clearly provided for in and envisaged by the planning policy for wind energy developments in west Clare.

Archaeology and Cultural Heritage

The archaeology and cultural heritage assessment of the proposed Cahermurphy Two Windfarm was prepared by Dominic Delany & Associates (DDA). The assessment is based on both a desktop review of the available archaeological and cultural heritage data and a comprehensive programme of field walking of the study area. A description of potential impacts is presented and mitigation measures are recommended where appropriate. The potential visual impact of the proposed development on recorded monuments is also assessed.

The archaeological heritage of the area was assessed in terms of national monuments / recorded monuments within two kilometres of the EIAR / primary study area. There is a recorded monument CL048-005 (Ringfort - cashel) located within the EIAR / primary study area. This monument is subject to a preservation order made under the National Monuments Act 1930-2014 (PO No. 4/1957) and consequently is designated as a National Monument. It comprises an almost circular cashel defined by a well-built drystone wall of small flags with a distinct batter. It is sited on the top of an east-west ridge named 'Cahermurphy Hill' and commands good views especially to the south of the county. The impact on the setting and visual amenity of the monument was assessed. Despite its prominent siting, the monument does not have a high visual amenity. The nearest turbines are over 800m to the north and northwest of the monument, where views are limited due to the rising topography of the land. Turbines will be visible within the views to the north and northwest and the impact on the setting of the monument is considered to be moderate. There is one recorded monument CL048-005001 (Hut site) located within the EIAR / primary study area. This monument comprises a hut site defined by a low drystone wall. It abuts the north interior of CL048-005 (Ringfort – cashel). The impact on the setting of this monument is slight.

A potential impact on an unknown archaeological resource lies in the uncovering of sub-surface archaeological features during the construction of the Proposed Development. Archaeological monitoring of all ground works will be undertaken during the construction stage in order to avoid any potential direct or indirect impacts on sub-surface archaeological material which may exist on the site.

The archaeological monitoring will be undertaken with the benefit of a licence from the Department of Culture Heritage and the Gaeltacht (DCHG).

A number of cultural heritage features were identified within the EIAR / primary study area. These include a ruinous vernacular structure, townland boundaries, field walls and a gate post formed of a single Liscannor flagstone. The townland boundary between Cahermurphy and Caheraghacullin is a substantial wall of drystone construction and there is another well-preserved field wall adjacent to a track in open ground in Carrownagry South. These walls do not have a high architectural or cultural heritage value but are good representative examples of the enclosure of marginal lands deemed suitable for grazing or cultivation. Proposed new access roads will breach the townland boundaries and field walls at a number of locations and the proposed upgrade to the access road between T2 and T3 will necessitate the displacement of the gate post. Mitigation includes minimisation of damage to field walls, recording by means of written descriptions and photographs of all sections of walling to be impacted by the development, salvage and reuse of the gate post and monitoring of groundworks.

The layout of the Proposed Development was designed sympathetically to the known cultural heritage features which exist on the site. Every effort was made to ensure that the development proposal would have the minimum impact possible by placing turbines, access roads and grid connection in areas which have no above ground archaeological, architectural or cultural heritage features. The project archaeologist was consulted extensively by the project design team during the design of the project, and various iterations of the proposed project layout, to ensure every effort was being made to minimise potential archaeological and cultural heritage impacts.

It is concluded that the proposed wind energy development will not have a significant effect on Archaeology and Cultural Heritage.

Material Assets

Traffic and Transport

An assessment of the traffic effects of the proposed Cahermurphy Two Wind Farm Development, consisting of 10 turbines, located in the townland of Cahermurphy, County Clare, was undertaken. The assessment presents the likely impacts of the proposed development during both the construction and operational stages of the development and considers the impact that the traffic generated by the proposed development would have on the local highway network. An assessment of the route geometry with respect to accommodating the abnormally sized vehicles required to deliver the turbine plant to the site was also undertaken.

The delivery route to the site for the abnormally sized loads required to transport the turbine components to the site (blades, towers and nacelles) comprises of the N68 to Ballyduneen, followed the R484 to Creegh. The route then heads east on the local road network through the village of Clooneenagh to the east of Cahermurphy Hill, before turning left to head northbound on towards the site access. It is noted that this is the same route that was used for the delivery of the abnormally sized loads for the Cahermurphy Phase 1 Wind Farm development, which is located just to the east of the subject site.

General construction traffic will travel to the site via the more direct route via the local road network to the site, which was also used for this purpose for the Cahermurphy Phase 1 Wind Farm Development.

The types of vehicles that will be required to negotiate the local network will be up to 74.6 metres long with a blade length of 68.5 metres. An assessment of the geometric requirements of the delivery vehicles was undertaken on the delivery route. Locations where it was established that the existing road geometry will not accommodate all of the vehicles associated with the proposed development are highlighted, with the extent of remedial works indicated. In addition to the assessment presented, it is

recommended that a dry run is undertaken by the transport company to check vertical and horizontal clearance on the transport route prior to construction.

In terms of daily traffic flows it is estimated that the impact of the development traffic on the delivery routes will be as follows:

- During the 10 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 6.1% on the N68 to an increase of 21.1% on the R484 leading to the site. As Castlepark Road currently provides for low traffic volumes, on these 10 days of the construction phase, flows are forecast to increase by almost 3 fold (186.8%). The effect will be temporary, lasting for 10 days, and will be slight to moderate.

- During the remaining 245 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 1.3% on the N68, to an increase of 4.6% on the R484 approaching the site. On the Castlepark Road it is forecast that traffic flows will increase by 40.4%. The effect will be temporary, lasting for 245 days, and will be slight.

- During the 10 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 0.9% on the N68, to an increase of 26.1 on the local Castlepark Road leading to the site. The effect during this period will be temporary and will be slight.

- During the 30 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 1.5% on the N68 to 17.2% on Creegh Road and 19.6% on Castlepark Road leading to the site, but will be temporary. The 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 and the key junction on the delivery route between the N68 / R484 will operate within operational capacity for all days within the construction period.

Once the facility is operational the traffic impact created by maintenance staff will be negligible.

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.

RTÉ Transmission Network (operating as 2rn), stated that that there is a risk of disruption to television reception for viewers to the west of the site that receive their signal from Maghera and for viewers to the northeast of the site that receive their signal from Knockanore. To mitigate against interference on viewers' television sets and/or broadcast radio receivers, RTÉ have recommended that a protocol agreement be put in place for the wind farm development. 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.

Of the scoping responses received from telephone, broadband and other telecommunications operators only Airspeed had telecommunication links in the area. On review by Airspeed it was concluded that the proposed wind farm location is below the link and therefore there was sufficient clearance available between the proposed development and the Airspeed link.

In June 2019, a scoping response was received from the Department of Defence (DoD) 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.*

In June 2019, a scoping response was received from the Irish Aviation Authority (IAA). The requirements of the IAA include the following:

1. *Agree an aeronautical obstacle warning light scheme for the wind farm development.*
2. *Provide as-constructed coordinates 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.*

In June 2019, a scoping response was received from Shannon Airport which included the following general comments:

4. *The siting of wind turbines at this location may have implications for the operations of the communication, navigation and surveillance systems used by Air Traffic Control for the separation and safety of aircraft. The geographical siting of these turbines may also have implications for the flight paths of aircraft.*
5. *Regard must be had to the Irish Aviation Authority (IAA) Obstacles to Aircraft in Flight Order, 2002 (S.I. No. 14 of 2002), as amended, which specifies the criteria used to determine whether or not any object anywhere in the state is deemed to be an obstacle affecting aircraft operations. Also, in order to assure the safety and efficiency of aircraft operations in the vicinity of airports, the International Civil Aviation Organisation (ICAO) has defined a volume of air space above which new objects are not permitted to interfere.*
6. *It would also be best practice that all wind energy developers should seek the views of the Irish Aviation Authority (IAA) at the pre-planning stage of consultation, with details of locations and proposed heights of turbines, to ensure that proposed developments do not cause difficulties with air navigation safety.*
7. *In the event that any potential adverse effects relating to this wind turbine development were identified as part of the consultation process, Shannon Airport Authority DAC would fully support any submission from the IAA.*
8. *Final, should planning permission be granted for this development in the future, we would ask that the planning authority stipulate the mandatory deployment of obstacle avoidance lighting on each individual wind turbine in the interests of flight safety.*

The nearest operational airport to the Proposed Development site is Shannon Airport, located approximately 32 kilometres southeast of the site, and therefore outside the range at which such issues would be expected.

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 15 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 16 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 5–15) of the EIAR.

1. INTRODUCTION

1.1 Introduction

This Environmental Impact Assessment Report (EIAR) has been prepared by MKO on behalf of Mid Clare Renewable Energy Windfarm Ltd., who intends to apply to Clare County Council for planning permission to construct a renewable energy development and all associated infrastructure in the townland of Cahermurphy and adjacent townlands, in Co. Clare.

This EIAR will accompany the planning application for the proposed development to be submitted to Clare County Council. The planning application will also be accompanied by a Natura Impact Statement ('NIS').

The proposed wind farm site is located approximately 5 kilometres to the north of Kilmihil and 25 kilometres southwest of Ennis, Co. Clare. It is proposed to access the site of the Proposed Development via an existing access track off the local road to the east of the site during the operational and construction phases. This entrance will be widened to facilitate the delivery of the construction materials and turbine components. The proposed wind farm site is further served by a number of internal existing forest roads.

It is proposed to connect the development to the national electricity network via a 38kV underground cable which will connect the proposed onsite substation to the existing Booltiagh substation, located approximately 7 kilometres to the southeast of the site. The substation and grid connection route are part of the proposd development and have been assessed as part of this EIAR.

Current land-use on the subject site comprises coniferous forestry, agriculture and turbary. Land-use in the wider landscape comprises a mix of agriculture, low density housing, wind farms and commercial forestry.

The proposed development is being brought forward in response to local, national, regional and European policy regarding Ireland's transition to a low carbon economy and associated climate change policy objectives. The site of the proposed development is located within an area designated in the Clare County Development Plan, 2017-2023 (as varied) as **'Strategic'** for wind energy development.

The townlands in which the proposed development is located are listed in Table 1-1.

Table 1-1 Townlands within which the Proposed Development is Located

Development Works	Townland
Wind turbines and access roads, Substation, Construction Compound, Borrow pits, Met mast, foresty felling and all associated site development works.	Cahermurphy, Knocknahila More South, Carrownagry South and Caheraghacullin.
Grid Connection Route	Cahermurphy, Drummin, Doolough, Carrownagry South, Glenmore and Booltiagh.

There are 56 occupied dwellings located within 1 kilometre of the turbine locations with 15 of those dwellings belonging to the landowners who form part of the proposed wind farm development. The closest occupied dwelling is located approximately 700 metres from the nearest proposed turbine location.

1.2 The Applicant and Project Background

The applicant for the proposed development is Mid Clare Renewable Energy Windfarm Ltd (MCRE). Coillte and MCRE are proposing to co-develop this project, also known as the Cahermurphy Two wind farm project.

Mid Clare Renewable Energy Windfarm Ltd (MCRE) is 100 percent Irish owned and is locally owned by Co. Clare based shareholders. The local ownership and local involvement is seen as an important feature in community acceptance of such renewable energy projects.

Coillte is a commercial semi-state company operating in forestry, land-based businesses, renewable energy and panel products. To date, Coillte has been the largest provider of high quality sites to the renewable energy sector and the Coillte estate has the potential to continue to make a significant contribution to achieving Ireland's 2030 target of sourcing 70% of its electricity consumption from renewable sources through wind energy generation, biomass production and the potential development of other renewable energy technologies.

Within Coillte, **Land Solutions** and **Renewable Energy** are active asset development and management businesses providing innovative commercial solutions to enable the attainment of key national policy objectives particularly those that are prescribed by the National Planning Framework (2018). The businesses span a wide range of industries including renewable energy, housing, healthcare, education, inward investment, infrastructure development, water, tourism and agriculture. Coillte has a longstanding heritage in the spheres of sustainability, recreation and community and a significant track-record in the renewable energy arena (specifically onshore wind through the development and construction of four wind farms totalling 230MW representing a total investment of over €400 million between 2010-2017).

In June 2019, Coillte established a new not-for-profit entity, **Coillte Nature**, which is dedicated to the restoration, regeneration and rehabilitation of nature across Ireland. Coillte Nature is seeking to deliver significant impact on the climate and biodiversity crises through innovative projects-of-scale across four strategic themes:

1. *Reforesting by planting new native woodland*
2. *Restoration of important biodiversity habitats*
3. *Regeneration of urban forests*
4. *Rehabilitation of critical ecosystem services*

Coillte is developing and will continue to develop renewable energy projects both on its own, in conjunction with codevelopment partners and with third party developers who require the lease or purchase of lands from Coillte in order to facilitate these developments, or an easement over the estate to develop their projects.

1.3 Brief Description of the Proposed Development

The proposed development will comprise the construction of up to 10 No. wind turbines and all associated works. The proposed turbines will have a maximum blade tip height of up to 170 metres. The full description of the proposed development, as per the public planning notices, is as follows:

i. *Construction of up to 10 No. wind turbines with a maximum overall blade tip height of up to 170 metres and associated hard stand areas;*
ii. *1 no. permanent Meteorological Mast with a maximum height of up to 100 metres;*
iii. *1no. 38kV permanent electrical substation which will be constructed at one of two possible locations on site: either Option A in Carrownagry South townland or Option B in Cahermurphy townland. The electrical substation will have 1 no. control building*

with welfare facilities, all associated electrical plant and equipment, security fencing, all associated underground cabling, waste water holding tank and all ancillary works;

iv. *All associated underground electrical and communications cabling connecting the turbines to the proposed on-site substation;*

v. *All works associated with the connection of the proposed wind farm to the national electricity grid via an underground cable to the existing Booltiagh 110kV substation;*

vi. *Upgrade of existing tracks, roads and provision of new site access roads and hardstand areas;*

vii. *Junction access road works;*

viii. *2 no. borrow pits;*

ix. *1 no. temporary construction compound;*

x. *Site Drainage;*

xi. *Forestry Felling to facilitate construction and operation of the proposed development; and*

xii. *All associated and ancillary site development works.*

This application is seeking a ten 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.

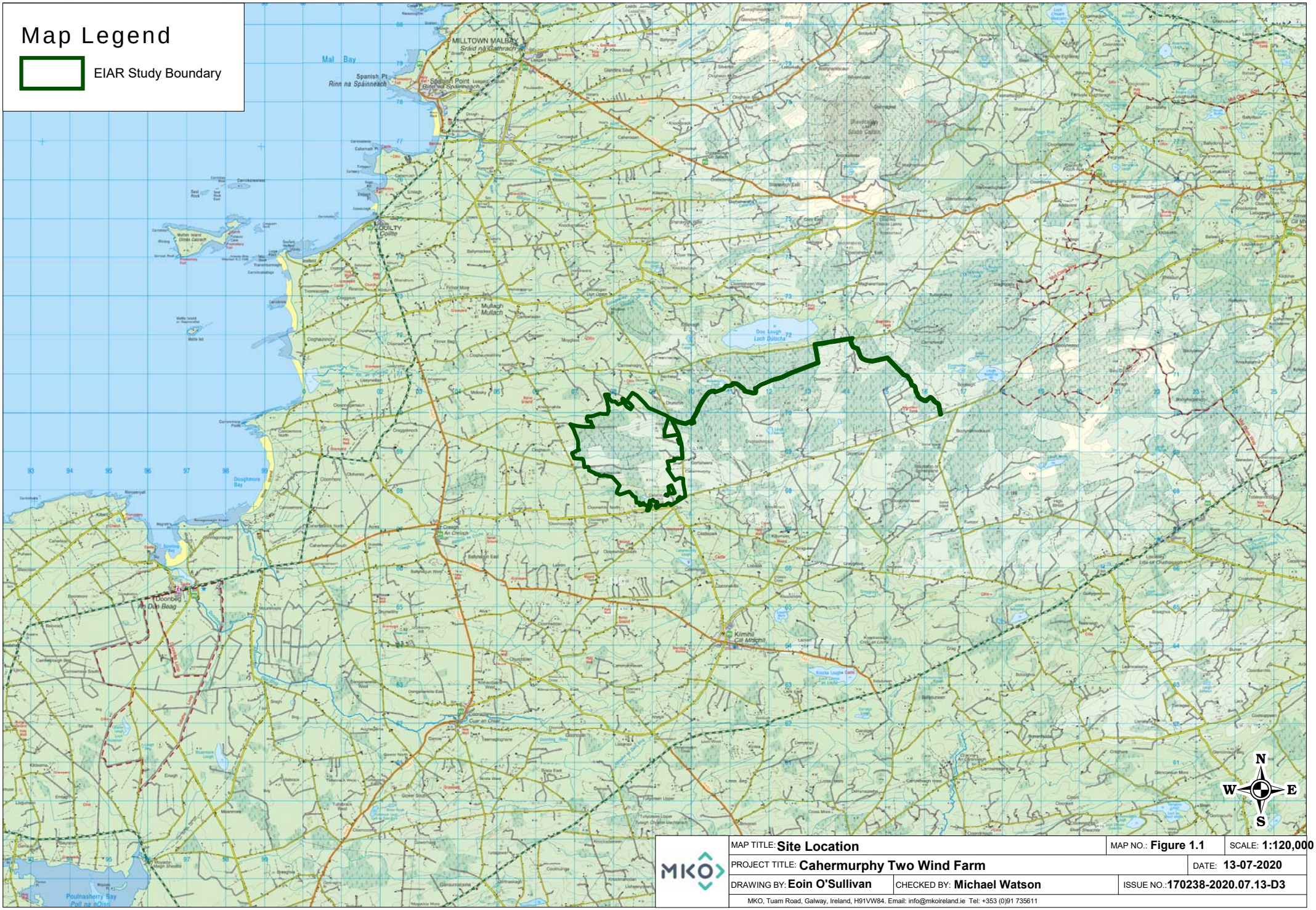
Modern wind turbine generators typically have an output of between 3.0 and 4.8MW. For the purposes of this EIAR it is assumed that the wind turbine model installed as part of the proposed wind farm development will have an output of 4.8MW. Therefore, based on 10 no. wind turbines, the wind farm will have a total output of 48MW.

The layout of the proposed development has been led by consideration of constraints and facilitators, thereby avoiding the environmentally sensitive parts of the site. The roads layout for the proposed development maximises the use of the existing onsite access roads and tracks where possible, with approximately 6.6 kilometres of existing roadway/ tracks requiring upgrading and approximately 4.9 kilometres of new access road to be constructed.

The planning application for the proposed wind farm includes connection to the national electricity grid. The planning application includes 2 No. substations; however, only one substation will ultimately be constructed.

The proposed wind farm will connect to the national grid via one of the following methods:

- Option A: It is proposed to construct a 38 kV substation at the northern end of the site and to connect from here to the existing Booltiagh 110kV substation, located approximately 7 kilometres to the southeast of the site. Option A also includes for an alternative cable route running from the proposed onsite substation south to the access road and north along the local road to the east of the site. The alternative cable route option measures approximately 1.7 km in length. Connection via the Booltiagh route would comprise underground cabling, measuring approximately 12.1 km in total, located on existing forestry and agricultural land and within the public road corridor.
  Or
- Option B: It is proposed to construct a 38kvV substation at the south eastern end of the site and to connect from here to the existing Booltiagh 110kV substation, located approximately 7 kilometres to the southeast of the site. Connection via the Booltiagh route would comprise underground cabling, measuring approximately 12.1 km in total, located on existing forestry and agricultural land and within the public road corridor.



MKO	MAP TITLE: **Site Location**	MAP NO.: **Figure 1.1**	SCALE: **1:120,000**
	PROJECT TITLE: **Cahermurphy Two Wind Farm**		DATE: **13-07-2020**
	DRAWING BY: **Eoin O'Sullivan**	CHECKED BY: **Michael Watson**	ISSUE NO.: **170238-2020.07.13-D3**

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Both Option A and Option B share the same grid connection route where the cable enters the forestry to the east of the wind farm site.

The substation options are required to provide flexibility to the electrical network provider when determining the most appropriate connection point for the export of the electricity to the national grid. The proposed on-site electrical substation will have 1 no. control buildings, associated electrical plant and equipment, and waste water holding tank.

Both substations options and the grid connection have been assessed as part of this EIAR.

As described above the majority of the proposed wind farm site is currently used for commercial forestry, a small proportion of which will be felled to accommodate the wind farm development. A total area of approximately 34.11 hectares of commercial forestry will require replanting elsewhere in the State and this forms part of the project for assessment. Details regarding the area to be felled are outlined in Chapter 4: Section 4.3.10 of this EIAR.

The Forest Service policy on the granting of felling licences requires replanting of forestry on a hectare-by-hectare basis. Four potential replanting areas have been identified for assessment purposes, with an availability of 36.72 hectares, located in Brackloon, Co. Roscommon, Cooraclare, Co. Clare, Pollnabrone, Co. Galway and Stranamart, Co. Cavan. These lands have been granted Forest Service Technical Approval[1] for afforestation, and this or similarly approved land will be used for replanting should the proposed development receive planning permission. Under the Forestry Regulations 2017, all applications for licences for afforestataion require the prior written approval (technical approval) of the Minister for Agriculture, Food and the Marine. Before the Minister can grant approval, he/she must first determine if the project is likely to have a a signifient environmental effect (for EIA purposes) and assess if the development, individually or in combination with other plans or projects is likely to have a significant effect on a European site (for Habitats purposes).

All elements of the overall project, including wind farm, grid connection, forestry felling, as well as the replanting have been assessed as part of this EIAR.

The proposed development and the replanting lands are described in detail in Chapter 4 of this EIAR.

1.3.1 References to the Proposed development Site

The EIAR site boundary of the proposed development encompasses an area of approximately 538 hectares, the majority of which comprises commercial forestry plantation. Where the 'site' is referred to in this EIAR, this means the primary study area for the EIAR. Generally, the study area extends beyond the planning application site 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 14.5 hectares, which represents approximately 2.7% of the primary study area. The primary study area for the development, is delineated in green on Figure 1-1.

1.4 Legislative Context of Environmental Impact Assessment

The consolidated European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, is currently transposed into Irish planning legislation by

[1] *All proposed forestry developments where the area involved is greater than 0.1 hectare must receive the prior written approval of the Forest Service. The application for approval is known as Pre-Planting Approval – Form 1.*

the Planning and Development Act 2000 (as amended) and the Planning and Development Regulations 2001 (as amended). Directive 2011/92/EU was amended by Directive 2014/52/EU which has been transposed into Irish law with the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018). The provisions of the new regulations have all come into operation as of 1st January 2019.

The European Union Directive 2011/92/EU, amended by EU Directive 2014/52/EU on the assessment of the effects of certain public and private projects on the environment (the 'EIA Directive'), requires Member States to ensure that a competent authority carries out an assessment of the likely significant effects of certain types of project, as listed in the Directive, prior to development consent being given for the project.

The Environmental Impact Assessment (EIA) of the proposed development will be undertaken by Clare County Council as the competent authority.

This EIAR complies with the EIA Directive in terms of the structure and content of the information required.

Article 5 of the EIA Directive provides where an EIA is required, the developer shall prepare and submit an EIAR previously referred to as an Environmental Impact Statement ('EIS'). 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.*

MKO was appointed as environmental consultants on this wind farm project and were commissioned to prepare this EIAR in accordance with the requirements of the EIA Directive.

The relevant classes/scales of development that require Environmental Impact Assessment (EIA) are set out in Schedule 5 (Part 1 and Part 2) of the Planning and Development Regulations 2001, as amended. 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 paragraph 3(i) of Part 2 of Schedule 5. 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 project 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 development.

All elements of the overall project, including grid connection, proposed tree felling and replanting have been assessed as part of this EIAR.

1.4.1 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.

1.4.2 Wind Energy Development Guideline 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.

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 concluded on the 19th of February 2020.

At time of writing, the Draft Guidelines have not yet been adopted, and the relevant guidelines remain those published in 2006. Notwithstanding this, however, due to the timelines associated with the planning process for renewable energy projects, it is possible that a version of the draft guidelines may be finalised during the consideration period for the current proposed development. Towards this end it is anticipated that Cahermurphy Two Wind Farm will be capable of adhering to the relevant noise and shadow flicker standards, and is in accordance with the set back requirements.

1.5 Need for the Proposed Development

1.5.1 Overview

Ireland faces significant challenges to its efforts to meet its 2020 targets, EU targets for renewable energy by 2030 and its commitment to transition to a low carbon economy by 2050. It is clear that Ireland will not meet its 2020 target for renewable energy as well as the longer-term movement away from fossil fuels, with the 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). Further detail can be found in Chapter 2 Section 2.2 of this EIAR.

In March 2019, the Government announced a renewable electricity target of 70% by 2030. The proposed development will be operational after 2020 and would therefore contribute to this 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). As such, the proposed Wind Farm 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 Ireland's 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.*

These factors are addressed in further detail below. Section 2.2 in Chapter 2 of this EIAR on Background to the Proposed Development, presents a full description of the international and national renewable energy policy context for the project. Section 2.3 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 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 agreement, 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 °C[2] and in accordance with the COP 21 agreement to limit global warming to well below 2°C above pre-industrial levels. Former Minister Kelly remarked in 2015 that "As a nation we must do everything in our power to curb our emissions".

In this regard, the Government enacted the Climate Action and Low Carbon Development Bill 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.

Most recently, the IPCC published an article on the 6th October 2018 titled 'Global Warming of 1.5°C', which 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. It provided detail on the impact of climate change if emissions are not reduced.

[2] IPCC Fifth Assessment Synthesis Report, Intergovernmental Panel on Climate Change AR5 Report

The Energy White Paper 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 will have a potential output of approximately 48MW. On this basis, the proposed development will result in the net displacement of approximately 64,254 tonnes of carbon dioxide (CO_2) per annum, including accounting for back-up generation. The carbon offsets resulting from the proposed development are described in detail in Section 11.3.3 of Chapter 11 of this EIAR: 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) but rose to approximately €4 billion in 2017 (the most recent period for which figures are available). Ireland's import dependency in 2017 was 66%, down 22% 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 2018*', Sustainable Energy Authority of Ireland, 2018).

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[3] called for a review of options to replace it with low carbon alternatives within a decade. Any steps to reduce this 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[4] 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".*

1.5.3.1.1 *Supports for 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."

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[3] *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

[4] *Ireland's Transition to a Low Carbon Energy Future 2015-2030 (Department of Communications, Energy & Natural Resources, 2015)*

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%[5], 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.

1.5.4 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 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.

In April 2020, the SEAI released an update to its 2019 'Renewable Energy in Ireland' report. The update report confirms that Ireland is not on track to meet any of its 2020 renewable energy targets and ranks second last of the 28 European countries (including the UK) in terms of progress towards 2020 targets. Renewable sources made up just 11% of Ireland's energy consumption in 2018, which is significantly short the 16% goal for 2020. The report notes that Ireland's dependence on fossil fuels for heating requirements (over 93%) was the primary cause for failing to achieve its overall renewable energy target.

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

Furthermore, analysis from EirGrid, has shown that 32% of electricity demand in Ireland during 2018 was met by renewable sources[6]. 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.

1.5.5 EU 2030 Renewable Energy Targets

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. This is a rise from the previous target of 55%. This commitment will also from part of a new Climate Action Plan that is being overseen by the Government. 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 is not on track for meeting our 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. Further detail on the EU 2030 targets in noted in Chapter 2 Section 2.2.

1.5.6 Increasing Energy Consumption

In their '*All Island Generation Capacity Statement 2018 - 2027'* (October 2018), EirGrid estimate that a band of between 3.9 and 4.4 GW of onshore wind energy capacity is required to meet Ireland's 2020 RES-E targets with 4.2 GW being the most likely figure and that this would imply an average build-out of about 300MW per year until the end of 2020. In April 2016[7] SEAI estimated the historic build rate for wind energy deployment as 180 MW per year since 2005. If this average build rate over the remaining period between 2018 and 2020 is assumed, then approximately 3.85 GW of wind would be built up to 2020, leaving an up to 550 MW shortfall on the current demand forecast.

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. 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 31% of all demand by 2027 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[8]. Alternatively, 3 MW of wind could be required per MW of data centre if the

6 http://www.eirgridgroup.com/newsroom/renewables-demand-record/index.xml
7 https://www.seai.ie/Publications/Statistics_Publications/Energy_Modelling_Group_Publications/Ireland%E2%80%99s-Energy-Targets-Progress-Ambition-and-Impacts.pdf
8 Data centres have high load factors of around 80%. Each 1MW uses 24 x 365 x 80% = 7GWh. EU targets require that 40% or 3GWh of that should come from renewables. A 1MW wind turbine produces roughly 3GWh/yr.

data centre wants to commit to being powered 100% by renewable energy. Many of the data centres have made such a commitment and have well-publicised company policies to only use renewable electricity to power their data centres.

In 2015, IWEA commissioned a study '*Data Centre Implications for Energy Use in Ireland'* which concluded that an extra approx. 1 Gigawatt (GW) of electricity demand could materialise between 2015 and 2020 due to growth in data centres. Many of the proposed data centres have committed to using 100% renewable energy which will result in an increased demand for renewable electricity as detailed above.

In the context of increasing energy demand and prices, uncertainty in energy supply and the effects of climate change, our ability to harness renewable energy such as wind power plays a critical role in creating a sustainable future. The Department of Environment, Heritage and Local Government set a target for Ireland of 40% of total electricity consumption to come from renewable resources by 2020, within an overall renewable energy target of 16%. This target forms part of the Government's strategy to make the green economy a core component of its economic recovery plan for Ireland. It is envisaged that wind energy will provide the largest source of renewable energy in achieving this target.

The European Commission Report '*Report from the Commission to the European Parliament and the Council*' on the 2017 progress made by Member States towards the national energy efficiency targets for 2020 and towards the implementation of the Energy Efficiency Directive, was published in November 2017. The report found that "*despite substantial reductions in the past that moved energy consumption closer to the 2020 targets, the increases in 2015 and possibly also in 2016 indicate that reaching the targets may require additional efforts*".

Recent communications from SEAI[9] have noted with concern that '*Significant progress has been made, but to realise Ireland's 2020 targets and reap the associated economic benefits requires an acceleration of effort'*.

Failure to meet Ireland's 2020 targets for renewable energy will result in substantial EU sanctions. SEAI in their report '*National Energy Projections to 2030'* (November 2018) anticipated that Ireland will fall short of its overall renewable energy target, predicting an estimated achievement of between 12.7% and 13.9% of the 16% target by 2020. More recently, Minister Bruton announced in May 2019 that fines of up to €150 million would be imposed for failure to reach the 2020 target. The Department of Public Expenditure and Reform (DPER) in their report 'Future Expenditure Risks associated with Climate Change/Climate Finance'[10] concluded that *'potential costs of purchasing non-ETS GHG compliance for the Irish Exchequer for the 2020 to 2030 period could have a cumulative total in the billions in the absence of any further policy changes'*. If Ireland decided to backfill shortfalls in the RES-H target with additional renewable electricity this could significantly reduce these costs.

The Department of Communications, Energy & Natural Resources (DCENR) noted in their Draft Bioenergy Plan 2014, that achieving the anticipated renewable energy usage in the three energy sectors will be challenging, with the 12% for renewable heat being particularly so. SEAI estimate that the shortfall could be in the region of 2% to 4% of the 12% RES-H target. Given that individual member state 2030 targets are expected to be set at a more challenging level than 2020, fines could persist for an extended number of years, and so the total cost to Ireland could run to billions. For comparison, the entire wholesale electricity market has an annual value of around €3bn.

Recognising the scale of this risk, the Department of Finance noted in its April 2016 'Stability Programme Update'

[9] https://www.seai.ie/resources/publications/Ireland___s-Energy-Targets-Progress-Ambition-and-Impacts.pdf
[10] https://igees.gov.ie/wp-content/uploads/2013/10/Future-Expenditure-Risks-associated-with-Climate-Change-Climate-Finance1.pdf

> *"There are fiscal risks associated with a legally binding EU Effort Sharing Decision on climate change covering the 2013-2020 period. Ireland is obliged to achieve a 20 per cent Greenhouse Gas emissions reduction (compared to 2005 levels) in certain sectors. Current EPA projections estimate that Ireland will not achieve this reduction and failure to comply may incur costs of hundreds of millions through the purchase of carbon credits until such time as the target is complied with. Similarly, further new costs may arise in the context of a new EU climate and energy framework for the period 2020-2030, which will set new emissions reduction targets."*

In the medium-term, with the introduction of electric vehicles and uptake of smart demand such as storage heating and heat pumps, emissions in the heat and transport sector will be substantially reduced. A high renewables electricity system is the foundation of such a transformation.

The Energy White Paper published by DCENR in December 2015 expanded on the vision set out above. It outlines a radical transition to a low carbon future which 'will involve [inter alia] generating our electricity from renewable sources of which we have a plentiful indigenous supply..[and].. Increasing our use of electricity and biogas to heat our homes and fuel our transport'.

The DCENR confirmed in the publication of the White Paper 'Ireland's Transition to a Low Carbon Future' 2015 – 2030, that wind is the cheapest form of renewable energy:

> *"(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."*

The 2020 40% electricity from renewable sources target has provided a particular focus for Irish Government policy and the renewables industry in recent years. However, 40% should only be considered as an interim target rather than an end in itself. Looking beyond 2020, EU countries have agreed on a new 2030 Framework for climate and energy, including EU-wide targets and policy objectives for the period between 2020 and 2030. These targets aim to help the EU achieve a more competitive, secure and sustainable energy system and to meet its long-term 2050 greenhouse gas reductions target. It is noted that a binding EU target of 32% for renewable energy by 2030 has been set by the EU 2030 Framework for Climate and Energy, with Ireland confirming its own targets for 2030 as detailed below.

Ireland will therefore have to meet even more demanding climate change and renewable energy supply obligations in order to play its part in achieving the European climate and energy ambitions. As announced in March 2019, the Irish Government have pledged to generate 70% of the country's electricity supply from renewable sources by 2030. This figure is up from the current target for that period of 55% and will form a commitment in the recent climate action plan[11] which was published in August 2019 and is being overseen by the Minister for Communications, Climate Action and the Environment. The development of additional indigenous wind energy generating capacity, such as that proposed at Cahermurphy, will not only help to reduce carbon emissions but will also improve Ireland's security of energy supply. Such penetration levels of wind are technically and economically feasible once paired with other energy system changes such as increasing electric vehicle penetration and electrification of heat. Further information on the 2030 commitments for Ireland are noted in Chapter 2, Section 2.2.

These sources of 'flexible demand' allow the system to match intermittent renewable energy resources with minimal extra cost. Additional interconnection is also planned with the UK and France, further assisting in the integration of wind (and in the future solar) on the power system.

A number of alternative energy types have been examined when considering how best to meet this renewable energy target.

[11] *Climate Action Plan 2019 – To Tacke Climate Breakdown (DCCAE 2019)*

In 2014, a report prepared by UK consultant BW Energy for the Rethink Pylons campaign group has suggested that converting Moneypoint generation station (which runs solely on coal) from coal to biomass would enable Ireland to meet 2020 renewable energy targets. Dr Brian Motherway, Chief Executive SEAI[12] refutes this claim. While Dr Motherway agrees that biomass offers benefits and is helping Ireland to move away from fossil fuels he states that "*the conversion of Moneypoint to biomass has been considered a number of times over the years, including actual trials of small amounts of biomass in the station. However, the technical and economic challenges have proven far greater than some would have us believe*".

The reason being that the move of Moneypoint from coal to biomass would not entail a clean swap. In fact, '*to allow for combustion of biomass, a full redesign and rebuild of much of the station would be required*'. In the UK where this has been done, energy generation stations have required significant financial support to make the process viable and with each unit of energy in the UK being worth approx. 13 cents, almost double that of Ireland which is approx. 7 cents, wind energy works out cheaper in Ireland. Also, the amount of biomass required to feed Moneypoint would require 300,000ha of land; an equivalent area of Counties Wexford and Carlow being planted with willow which is far more than Ireland currently produces which means we would need to import.

Importation raises the question; would this be cost effective? As prices are volatile and availability of biomass is difficult to predict Ireland would become dependent on the uncertainty of imported biomass. It is also noted that there will be emissions from transport and distribution. The further the biomass is transported, the greater the greenhouse gas emissions[13]. So, while biomass is currently contributing to a move to renewable energy production, on its own it is not the sole answer to meeting Ireland's 2020 renewable energy targets. Ireland has a legal obligation to diversify its energy sources by 2020 requiring the development of renewable energy to avoid substantial fines.

More recently, and with the 2030 targets being released; the Joint Committee on Climate Action has published its cross-party report entitled, '*Climate Change: A Cross- Party Consensus for Action'* (March 2019). This report highlights the requirements for alternate energy production. More specifically, the report notes that it is currently planned to stop burning coal at Moneypoint by 2025 as well as peat at Bord na Mona and ESB stations by 2030. In August 2019, the Department of Communications, Climate Action and Environment published its Climate Action Plan (CAP), which notes the need for renewable alternatives to coal and peat. Further information on the CAP can be seen in Chapter 2, Section 2.2.4.

Against this backdrop, the importance of wind energy as the main component of Ireland's renewable energy development is acknowledged, and wind energy is accepted as the main contributor to meeting the Country's national climate change and energy supply obligations. Notwithstanding this, it must also be acknowledged that not every part of Ireland is well endowed with wind resources and therefore, not all counties will be able to deliver wind-based renewable energy. Furthermore, whilst it is accepted that there are other renewable energy technologies in operation, for the foreseeable future many areas will be unable to deliver significant renewable energy output. This primarily applies to the more populous areas.

National and international renewable energy and climate change targets must be achieved and it is crucial that these are appropriately translated and implemented at regional and local levels. Wind farm development and design involves balancing the sometimes-conflicting interests of constraints (e.g. natural and built heritage, human beings, ecological, ground conditions, hydrological, etc.) with visual amenity and the technological/economic requirements/realities of the specific project and turbines.

[12] http://www.seai.ie/News_Events/Press_Releases/2014/Biomass-is-a-big-part-of-the-solution-but-not-the-whole-solution.html
[13] *Sustainability Criteria Options and Impacts for Irish Bioenergy Resources (SEAI 2019)*

1.5.7 Programme for Government – 'Our Shared Future' – 2020

In Jun 2020, a draft programme for government was agreed by the leaders of Fine Gael, Fianna Fail and the Green Party. The draft programme contains commitments under a number of policy headings which inlcude:

- A better quality of life for all;
- Reigniting and renewing the economy;
- A green new deal;
- Universal healthcare;
- Housing for all;
- Balanced regional development;
- A new social contract;
- Building stronger and safer communities;
- Better opportunities through education and research;
- A shared island;
- At the heart of Europe and global citizensip; and
- Reforming and reimagining our public life.

Under the 'Green New Deal', The government is committed to an averarage 7 per cent per annum reduction in overall greenhouse gas emissions from 2021 to 2030, which is a 51 per cent reduction over the decade, with the aim of achieving net zero emissions by 2050. The 2050 target will be set in law by the Climate Action Bill.

The proposed development is likely to be operational before 2030 and would therefore will contribute to this 2030 target.

1.5.8 Reduction of Carbon Emissions and Other Greenhouse Gases

The production of renewable energy from the proposed development 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 targets are divided out amongst each county, each Local Authority may be responsible for meeting its own targets.

In addition to a reduced dependence on oil and other imported fuels, the generation of electricity from wind power by the proposed development will displace approximately 64,254 tonnes of carbon emissions per annum from the largely carbon-based traditional energy mix, the detail of which is presented in Section 11.3.3 in Chapter 11 of this EIAR.

Under WHO and EU estimates, more than 400,000 premature deaths are attributable to poor air quality in Europe annually ('*Ireland's Environment: An Assessment*', Environmental Protection Agency, 2016). In Ireland, the premature deaths attributable to air pollution are estimated at 1,200 people per year. The EPA 2016 report '*Ireland's Environment – An Assessment*' states that the pollutants of most concern are NOx, (the collective term for the gases nitric oxide and nitrogen dioxide, PM (particulate matter) and O_3 (ozone). The EPA 2016 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.

1.5.9 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 over 35,040 households every year, as presented in the calculations in Section 4.3.1.6 of this EIAR.

At a Regional Level, the proposed development will help to supply the rising demand for electricity, resulting from renewed economic growth. The EirGrid report '*All-island Generation Capacity Statement 2018 – 2027*' (October 2018) notes that the demand forecast in Ireland is heavily influenced by the expected growth of large energy users, primarily data centres and that *'due to this growth, the electricity demand in Ireland could grow by up to 57% in the next 10 years'*.

The proposed development will have both long-term and short-term benefits for the local economy including income to local landowners, job creation, work opportunities for local businesses and service providers, local authority commercial rate payments and a Community Benefit Scheme.

Commercial rate payments from the proposed project will be provided to Clare County Council each year, which will be redirected to the provision of public services within Co. Clare. 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.

It is estimated that the proposed project has the potential to create up to 72 jobs during the construction, operational and maintenance phases of the proposed wind farm. During construction, additional employment will be created in the region through the supply of services and materials to the

wind farm. There will also be income generated by local employment from the purchase of local services i.e. travel, goods and lodgings. Further details on employment associated with the proposed wind farm are presented in Section 5.8 of this EIAR.

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 up to €5.6 million will be made available over the lifetime of the project. Further details on the proposed Community Gain proposals are presented in Section 4.5 of this EIAR.

The value of this fund will be directly proportional to the level of installed MWs 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.

1.6 Purpose and Scope of the EIAR

The purpose of this EIAR is to document the current state of the environment on and in the vicinity of the proposed site and to quantify the likely significant effects of the proposed development on the environment. 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 Clare County Council, from the EIAR accompanying the 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 significant effects of the project on the following:

a) *population and human health*
b) *biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC*
c) *land, soil, water, air and climate*
d) *material assets, cultural heritage and the landscape*
e) *the interaction between the factors referred to in points (a) to (d)*

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

1.7 Structure and Content of the EIAR

1.7.1 General Structure

This EIAR uses the grouped structure method to describe the existing environment, the potential impacts of the proposed wind farm 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, water, 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)
- Birds
- Land, Soils and Geology
- Hydrology and Hydrogeology
- Air and Climate
- Noise and Vibration
- Landscape and Visual
- Cultural Heritage
- Material Assets (including Traffic and Transport, Telecommunications and Aviation)
- Interactions of the Foregoing
- Schedule of Mitigation 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.

1.7.2 Description of Likely Significant Effects and Impacts

As stated in the *'Guidelines on the Information to be contained in Environmental Impact Statements'* (EPA, 2002), an assessment of the likely impacts of a 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 Environmental Protection Agency (EPA):

- *'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)

The European Commission 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', which have also been referred to.

Table 1-2 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

Impact Characteristic	Term	Description
Extent & 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
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,

Impact Characteristic	Term	Description
		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, duration 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.

1.8 Project Team

1.8.1 Project Team Responsibilities

The companies and staff listed in Table 1-3 were 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 0 below. Each chapter of this EIAR has been prepared by a competent expert in the subject matter.

Table 1-3 Companies and Staff Responsible for EIAR Completion

Consultants	Principal Staff Involved in Project	EIAR Input*
MKO Tuam Road, Galway, H91 VW84	Gus McCarthy Brian Keville Michael Watson Eoin O'Sullivan Jimmy Green Meabhann Crowe Paul Sweeney Pat Roberts John Hynes Dr. Úna Nealon Aoife Joyce Sarah Mullen Dervla O'Dowd Padraig Cregg Ciaran McKenna David Naughton Owen Cahill Dr. John Staunton Stephen Corrigan Patrick Hehir Joanna Mole James Newell Joseph O'Brien	Project Managers, Scoping and Consultation, Preparation of Natura Impact Statement, EIAR Report Sections: 1. Introduction 2. Background to the Proposed Development 3. Site Selection & Alternatives 4. Description of the Proposed Development 5. Population & Human Health 6. Shadow Flicker 7. Biodiversity 8. Birds 11. Air & Climate 13. Landscape & Visual 15. Material Assets (non-Traffic) 16. Interaction of the Foregoing
Hydro Environmental Services 22 Lower Main Street Dungarvan Co. Waterford	Michael Gill David Broderick	Flood Risk Assessment, Drainage Design, Preparation of EIAR Sections: 9. Land, Soils & Geology 10. Hydrology & Hydrogeology
Fehily Timoney & Company The Grainstore Singletons Lane Bagnelstown Co. Carlow	Gerry Kane Ian Higgins	Preparation of Peat Stability Assessment & Peat Management Plan

Consultants	Principal Staff Involved in Project	EIAR Input*
AWN Consulting The Tecpro Building Clonshaugh Business & Technology Park Dublin 17	Damian Kelly Dermot Blunnie Mike Simms	Baseline Noise Survey, Preparation of EIAR Section 12. Noise and Vibration
Dominic Delaney & Associates Unit 3 Howley Court Main Street Oranmore Co. Galway	Dominic Delaney	Preparation of EIAR Section 14. Cultural Heritage
Alan Lipscombe Traffic and Transport Consultants Claran, Headford, Co. Galway	Alan Lipscombe	Swept Path Analysis, Preparation of EIAR Section 15. Material Assets - Traffic and Transport

* (A Statement of Authority is included in each chapter of this EIAR detailing the the experts who contributed to the preparation of the report, identifying for each such expert the part or parts of the report which he or she is responsible for or to which he or she contributed, his or her competence and experience, including relevant qualifications in relation to such parts, and such additional information in relation to his or her expertise that demonstrates the expert's competence in the preparation of the report and ensures its completeness and quality.

1.8.2 Project Team Members

1.8.2.1 MKO

Gus McCarthy BA, MRUP, MIPI

Augustine (Gus) McCarthy is a Company Director with McCarthy Keville O'Sullivan Ltd. and is a professional planner with over 35 years of experience in both private practice and local authorities combined. Prior to establishing AP McCarthy Planning Consultants in 2000, Gus worked as a Senior Planner for both Galway County Council and Galway City Council. Gus has significant experience in a wide range of projects and extensive experience in both terrestrial and coastal/marine based developments. He is retained as planning advisor for development programmes of large organisations and has been the lead planning consultant on a wide range of infrastructure, energy, commercial and other projects throughout the Country.

Brian Keville B.Sc. (Env.)

Brian Keville has over 18 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. 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, CEng, PGeo

Michael Watson has over 19 years' experience in the environmental sector. Following the completion of his Master's Degree in Environmental Resource Management, Geog from National University of Ireland, Maynooth he worked for the Geological Survey of Ireland and then a prominent private environmental & hydrogeological consultancy. Michael's professional experience includes managing Environmental Impact Assessments on behalf of clients in the renewable energy, waste management, commercial and industrial sectors nationally. These projects have required liaising with the relevant local authorities, Environmental Protection Agency (EPA) and statutory consultees as well as coordinating the project teams and sub-contractors. Michael has significant experience in the EPA Industrial Emissions, IPPC and Waste licensing regimes managing licence applications and subsequent regulatory compliance on behalf of clients in the waste and industrial sectors. Michael also has a Bachelor of Arts Degree in Geography and Economics from NUI Maynooth, is a Member of IEMA, a Chartered Environmentalist and Professional Geologist.

Jimmy Green BA, MRUP; MIPI

Jimmy Green is a Senior Planner with McCarthy O'Sullivan Ltd. with over 18 years of experience in both private practice and local authorities. Jimmy holds a Bachelor of Arts Degree (BA) in both Human and Physical Geography from the National University of Ireland, Galway as well as a Masters in Regional and Urban Planning (MRUP) from University College Dublin. Prior to taking up his position with McCarthy Keville O'Sullivan in 2004, Jimmy worked as an Assistant Planner, Executive Planner and Senior Executive Planner in Galway County Council and as an Assistant Planner in Donegal County Council. Jimmy is primarily involved in co-ordinating and preparing Environmental Impact Assessment Reports, leading significant and complex development proposals through the planning process (from feasibility, through application, appeals and judicial processes) and has a strong ability to work with many other disciplines and individuals, as well as with Council officials, elected members and members of the public. Jimmy also manages a planning team within MKO in order to ensure timely delivery of project outputs. Jimmy has significant experience in dealing with Strategic Infrastructure Development proposals, Environmental Impact Assessment Reports, Environmental Impact Assessment, Renewable Energy, Electrical Infrastructure proposals, as well as the full range of Commercial, Retail, Residential and Industrial developments. Jimmy is a corporate member of the Irish Planning Institute.

Eoin O'Sullivan M.Sc., B.Sc., CWEM; CEnv

Eoin O'Sullivan is a Senior Environmental Consultant with McCarthy Keville O'Sullivan Ltd. with over 10 years of experience in the assessment of a wide range of energy and infrastructure related projects and working in the fields of environmental and human health risk assessment, waste management, waste policy and permitting. Eoin holds a BSc (Hons) in Environmental Science & Technology and a MSc in Environmental Engineering. Prior to taking up his position with McCarthy Keville O'Sullivan in July 2017, Eoin worked as a Chartered Senior Engineer with CGL in Surrey, UK. Prior to this Eoin worked as a Project Engineer with RPS Consulting Engineers in Belfast. Eoin has wide experience in the project management of large scale infrastructural projects and brownfield developments and has routinely undertaken detailed quantitative risk assessment for the protection of controlled waters and ground gas risk assessments. Eoin has also experience in completing PPC Permit Applications and in the preparation of Environmental Impact Statements/Environmental Impact Assessment Reports for renewable energy projects, quarries and a number of non-hazardous landfill sites and anaerobic digesters for both public and private clients. Other key strengths and areas of expertise include remediation options appraisals, remediation method assessments and waste management planning. Eoin is a Chartered Member of the Chartered Institute of Water and Environmental Management and Chartered Environmentalist with the Society of Environment.

Meabhann Crowe BA (Hons), M.Sc.

Meabhann Crowe is a Project Planner with McCarthy O'Sullivan Ltd with over 10 years private sector experience. She is a fully chartered member of the Royal Town Planning Institute (MRTPI). Meabhann holds a BA (Hons) in Geography, Sociological and Political Science and a Masters in Urban and Regional Planning. Prior to taking up her position with McCarthy Keville O'Sullivan in October 2018, Meabhann was employed as an Associate Director with Colliers International in their Edinburgh office, prior to which she was employed for several years with Halliday Fraser Munro. In her time in the industry Meabhann has been active on a number of instructions across a broad spectrum of mixed-use, residential, commercial, renewable energy and retail projects.

Meabhann brings particular expertise in initial development feasibility appraisals and development strategies. Her experience in managing large multi-disciplinary teams in the preparation of local and major planning applications across residential and mixed-use and retail developments means she has a wealth of knowledge to draw on in the early stages of development. She has particular experience in preparing and managing site strategies which include both responding to emerging planning policy whilst also preparing and progressing planning applications and appeals.

Paul Sweeney BA. M.Sc.

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.

Pat Roberts B.Sc. (Env.)

Pat Roberts is a Senior Ecologist and director of the Ecology team with McCarthy Keville 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 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),

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

John Hynes is a Senior Ecologist with McCarthy Keville O'Sullivan Ltd. with over 5 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 EIAR Reports. John has project managed a range of strategy and development projects across Ireland and holds CIEEM membership.

Una Nealon PhD, B.Sc.

Úna Nealon is a Project Ecologist with McCarthy Keville 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 EIA 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.

Aoife Joyce M.Sc. (Agribioscience), B.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 NUIGalway, 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, sound analysis, 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 managing bat survey requirements for a variety of wind farm planning applications, as well as commercial, residential and infrastructure projects. This includes scope, roost assessments, deploying static bat detectors and weather stations nationwide, dawn and dusk bat detection surveys, acoustic analysis, mapping, impact assessment 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 CIEEM and holds a current Bat Roost Disturbance licence.

Sarah Mullen PhD, M.Sc, B.Sc

Sarah Mullen is an Ecologist with McCarthy Keville O'Sullivan Ltd. with 3 years of experience in consultancy. Sarah holds a B.Sc. (Hons) in Botany, an M.Sc. in Biodiversity and Conservation and a Ph.D. in Botany, in which she investigated the role of biodiversity in the functioning of plant-pollinator interactions in semi-natural grassland habitats. Prior to taking up her position with McCarthy Keville O'Sullivan in September 2018, Sarah worked as an Ecologist with Ryan Hanley Ltd. where she gained experience in multidisciplinary ecological surveys, ecological impact assessment and appropriate assessment. Sarah also has experience working with Indigo Development and Change, a conservation focused NGO in South Africa and with the German branch of the Global Biodiversity Information Facility (GBIF) in the Museum für Naturkunde in Berlin. Sarah's key strengths and areas of expertise are in terrestrial flora and fauna ecology, including vegetation surveys, habitat mapping, invasive species surveys, mammal surveys, Appropriate Assessment and Ecological Impact Assessment. Since joining MKO Sarah has been involved as an ecologist on various energy infrastructure, commercial and water services projects. Within MKO Sarah plays a large role in preparing Ecological Impact Assessment reports and Stage 1 and Stage 2 Appropriate Assessment reports. Sarah holds membership with the Chartered Institute of Ecology and Environmental Management.

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

Dervla O'Dowd is a Senior Ecologist and Project Manager with McCarthy Keville 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 & 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 and current Safe Pass card.

Padraig Cregg M.Sc., B.Sc.

Padraig Cregg is a Senior Ornithologist with McCarthy Keville O'Sullivan Ltd. with over 7 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.

Ciaran McKenna BA (Hons)

Ciarán is a Field Ornithologist with McCarthy O'Sullivan Ltd. with over 3 years of experience in ecology consultancy. Ciarán holds BA (Hons) in Wildlife Biology. Prior to taking up his position with McCarthy Keville O'Sullivan in March 2018, Ciarán worked as a graduate ecologist with Malachy Walsh and Partners, and was a freelance ecology consultant. Ciarán has knowledge of an array of ecological survey techniques including; mammal, bat, bird, and habitat. Ciarán's key strengths are in the area of ornithological surveys and he has training and experience for rough upland terrain.

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 & 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.

Owen Cahill B.Sc., M.Sc.

Owen is an Environmental Engineer with McCarthy Keville O'Sullivan Ltd. with over 10 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 Specialist 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 & solar energy construction & 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 EIA 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.

John Staunton PhD, B.Sc.

John Staunton is a Project Environmental Scientist with McCarthy Keville O'Sullivan Ltd. with over 10 years of postgraduate experience in both research and private consultancy. John holds both a BSc (1st class Hons) and a PhD in Environmental Science. Prior to taking up his position with McCarthy Keville O'Sullivan in October 2014, John worked as a research assistant for several soil and hydrogeological contamination research projects being undertaken by the Earth and Ocean Sciences department in NUI Galway. John also carried out research as part of a PhD, is lead author on four international peer-reviewed scientific papers, and presented at numerous national and international conferences. John's key strengths and areas of expertise are in project management, report writing, map making, communication and impact assessments. Since joining MKO, John has been involved as a Project Environmental Scientist on a significant range of energy infrastructure projects, hydrological and ecological monitoring, report writing of Environmental Reports (ER), Environmental Impact Statements/Environmental Impact Assessment Reports (EIS/EIAR) & Strategic Environmental Assessments (SEA) and carrying out research/literature reviews. This is in addition to project managing multiple jobs ranging from small projects to multi-million euro energy developments. Within MKO John works as part of a large multi-disciplinary team to produce EIS/EIAR, ER and SEA documents.

Stephen Corrigan B.Sc.

Stephen Corrigan is an Environmental Scientist with McCarthy Keville O'Sullivan Ltd. with over 2 years of experience in private and public sector positions. Stephen holds a B.SC in Environmental Science. Stephen has specialist knowledge in environmental field surveys, database management, geographic information systems and data analysis. Stephen's key strengths and areas of expertise are in data management and GIS. Since joining MKO Stephen has been involved as an Assistant Environmental scientist on a significant range of energy infrastructure and private/public development projects, hydrological and ecological monitoring projects. Within MKO Stephen has a role in site construction monitoring, report writing and database management. Stephen works as part of a large multi-disciplinary team to produce EIA Reports, operational compliance reports and monitoring reports for MKO.

Patrick Hehir B.Sc. (Hons), M.Sc.

Patrick Hehir is an Environmental Scientist with McCarthy Keville O'Sullivan Ltd. with over 10 years of experience in private practice. Patrick holds BSc (Hons) in Construction Management and Masters in Environmental Science. Prior to taking up his position with McCarthy Keville O'Sullivan in January 2016, Patrick worked as a Quality Manager and Environmental Coordinator with BAM Ireland Ltd. and held previous posts with Allnorth Consultants in Canada, the M3 Motorway JV, Stanger Testing Ireland, the M4 Motorway JV and Coffey Construction Ltd. Patrick has specialist knowledge in day-to-day monitoring, oversight, auditing and reporting of the implementation of all planning and environmental requirements for on-site wind farm developments. Patrick's key strengths and areas of expertise are in project management, hydrology, waste management, environmental auditing, site and construction supervision, water quality monitoring and renewable energies. Since joining MKO Patrick has been involved as a Site Environmental Officer (SEO)/Planning Compliance Officer (PCO) on a large energy infrastructure project with a projected output of circa 85MW of wind energy, pre-planning compliance of new wind energy infrastructure projects and project management of industrial EPA compliance projects. Within MKO Patrick plays a large role in the management and confidence building of junior members of staff through his experience gained on large infrastructural projects both in Ireland and internationally.

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 15 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.

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 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. Prior to joining us, Joseph worked as a free-lance Modelmaker and CAD Technician. His previous experience included designing various models and props through CAD and then making them for various conventions such as Dublin Comic Con and Arcade Con.

1.8.2.2 Hydro Environmental Services Ltd

Michael Gill

Michael Gill is an Environmental Engineer with over ten years' environmental consultancy experience in Ireland. Michael holds an honours degree in Civil and Environmental Engineering from Trinity College Dublin (TCD), as well as a research M.Sc. in Wetland Hydrology also from TCD. Michael also

holds a diploma in Geology from University College Cork and a second M.Sc. in Applied Hydrogeology, from Newcastle University. Michael is a member of International Association of Hydrogeologists (IAH) and was a member of the conference sub-committee from 2003 until 2009. He is also a Member of Engineers Ireland (MIEI), a Member of the Chartered Institute of Water and Environmental Management (CIWEM) and a professional member of the Institute of Geologists (IGI). 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. David holds a B.Sc. in Environmental Science, University of Wales, Aberystwyth (2001), as well as a H. Dip. Environmental Engineering, Trinity College Dublin (2004). David also completed a M.Sc. in Hydrogeology at University of Leeds (2006). David is a member of International Association of Hydrogeologists (IAH). 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 EIARs for a range of commercial developments.

1.8.2.3 Fehily Timoney

The geotechnical aspects of the report, which are incorporated into the Geology & Soils and Water sections of the EIAR, have been completed by Fehily Timoney. Fehily Timoney has extensive experience in the production of Peat Stability Assessments for wind energy developments. Fehily Timoney provides 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 Fehily Timoney (formerly AGEC) 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 & 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 holds a BSc in Engineering Geology from the University of Sunderland and an MSc in Geotechnical Engineering from Heriot-Watt University in Edinburgh. Ian is a Member of the Institute of Engineers of Ireland and a Fellow of the Geological Society of London. Ian is a geotechnical engineer with over 18 years' experience in the design and supervision of construction of bulk earthworks, geotechnical foundation design, geotechnical monitoring and reviewing, reinforced earth design 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. Ian's responsibilities include managing junior engineers, reviewing work

carried out for ground investigation, reporting and design. Ian has also experience in using a number of geotechnical software packages including slope stability, finite element, pile design and retaining wall design.

1.8.2.4 AWN Consulting Ltd

Damian Kelly – Director (Acoustics)

Damian Kelly (Director (Acoustics)) holds a BSc from DCU and an MSc from QUB. He has extensive experience as an acoustic consultant working in the field since 1997 and is a member of the Institute of Acoustics. He is currently a sitting member of the Irish committee of this organisation. 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. Damian has prepared an extensive number of wind farm noise impact assessments throughout the country.

Dermot Blunnie - Senior Acoustic Consultant

Dermot Blunnie (Senior Acoustic Consultant) holds a BEng 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 of all aspects of environmental surveying, noise modelling and impact assessment for various sectors including, energy, industrial, commercial and residential. Dermot specialises in wind farm noise modelling, compliance and complaint investigations.

Mike Simms - Senior Acoustic Consultant

Mike Simms (Senior Acoustic Consultant) holds a Bachelor of Mechanical Engineering and Master of Engineering Science from University College Dublin he also holds a Diploma in Acoustics and Noise Control from the University of Ulster at Jordanstown. He has 16 years' experience in the field of environmental acoustics, in particular using computer-based noise modelling for environmental noise assessments.

1.8.2.5 Dominic Delaney & Associates

Dominic Delaney BA, MIAI

Dominic Delany graduated from University College Galway in 1986 with a BA (honours) degree in archaeology and history. He is licensed by the state to carry out archaeological excavations in Ireland since 1989 and has over 25 years of experience in the provision of archaeology and cultural heritage services to public and private sector clients. Dominic Delany & Associates was established in 2002 and the company has demonstrated its ability to provide archaeological mitigation to developments through management and co-ordination of projects from pre-planning assessment stage to archaeological resolution of sites. Dominic has accumulated a wealth of experience on all aspects of Irish archaeology. He has vast experience in archaeological excavation and has directed some of the most important excavations in Galway City such as the Red Earl's Hall, a 13th century Anglo-Norman building in the city centre and Bollingbrook Fort, a Cromwellian siege fort on the eastern approach to the city. He has project managed numerous large scale archaeological projects most notably the Broadband Projects or Metropolitan Area Networks (MAN's) for over 30 towns in Ireland, the towns and villages sewerage schemes for counties Leitrim and Wexford, and the gas feeder and distribution networks for a number of towns in the West of Ireland. Dominic has over 15 years of experience in the compilation of archaeology and cultural heritage chapters for Environmental Impact Assessment Reports with projects ranging from residential, commercial and industrial developments to strategic infrastructure projects such as pipelines and wind farms.

1.8.2.6 Alan Lipscombe Traffic and Transport Consultants

Alan Lipscombe

Alan holds a BEng (Hons) in Transportation Engineering from Napier University and is a Member of the Chartered Institute of Highways and Transportation and a member of the Institute of Engineers, Ireland. 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 Difficulties Encountered

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

1.10 Viewing and Purchasing of the EIAR

Copies of this EIAR will be available online, including the Non-Technical Summary (NTS), on the Planning Section of the Clare County Council website, https://www.clarecoco.ie/services/planning/planning-applications/, under the relevant Planning Reference Number (to be assigned on lodgement of the application).

This EIAR and all associated documentation will also be available for viewing at the offices of Clare 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:

Clare County Council
Áras Contae an Chláir
New Road
Ennis
Co. Clare
V95 DXP2

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).

2. BACKGROUND

This section of the EIAR presents policy information on Energy and Climate Change policy and targets, the strategic, regional, and local planning context for the proposed development, scoping and consultation, and the cumulative impact assessment process. An assessment of alternatives is included at Chapter 3 of this EIAR.

2.1 Introduction

This section of the EIAR presents the various policies and targets which have been put in place at the various levels of Government both national and international in relation to renewable energy and climate change. The details below set out the need for the proposed development to aid Ireland in meeting its national targets and European commitments in relation to climate change and decarbonisation. It is of note that latest projections have shown that Ireland is not set to meet its 2020 targets.

This section is structured as follows:

- 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.

2.2 Renewable Energy Policy and Targets

2.2.1 Renewable Energy Resources

Renewable energy resources include solar, wind, 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 (Source: Sustainable Energy Authority of Ireland (SEAI) website, www.seai.ie).

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;
- 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 66% of Ireland's dependency in 2017 at an estimated cost of €4 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. ('*Energy in Ireland 2018 Report*', Sustainable Energy Authority of Ireland', December 2018).

2.2.2 EU Legislation

The European Union (EU) Directive on the Promotion of the Use of Energy from Renewable Sources (Directive 2009/28/EC) was adopted on 23rd April 2009. This Directive establishes a binding target of 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. Ireland's target under Directive 2009/28/EC is for renewable resources to account for 16% of total energy consumption by 2020. Directive 2009/28/EC imposes a legal obligation on each Member State to:

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

Failure to meet EU targets on the use of energy from renewable sources could result in EU sanctions *('Jobs and Investment in Irish Wind Energy'*, Deloitte/Irish Wind Energy Association, 2009).

Ireland's mandatory target under Directive 2009/28/EC 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.

2.2.2.1 2030 Climate Change and Energy Framework 2014

The 2030 Climate and Energy Framework was adopted by EU leaders in October 2014 and 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 Green House 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.

On the 30 November 2016, the EU Commission published a proposal for a revised Renewable Energy Directive to ensure that the target of at least 27% renewables in the final energy consumption in the EU by 2030 is met.

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 below in Section 2.3 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 introduced a binding renewable energy target for the EU for 2030 of at least 32% (up from 27%) of final energy consumption.

2.2.2.2 Progress on Targets

The overall share of renewables in primary energy in Ireland stood at 11.1% in 2018 which is up from the 2017 figure of 7.3%, 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 SEAI's Energy in Ireland 2018 Report, the contribution from renewables in 2005 was 2.8%, which as of 2017, has risen to 10.6% of the GFC. The SEAI's 2018 Report continues to note that 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 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 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 pace of 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.

Plate 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 Plate 2.1, are still considerably below meeting its 2020 target. Per the 2018 data Ireland was at 11.1% of its 16% target.

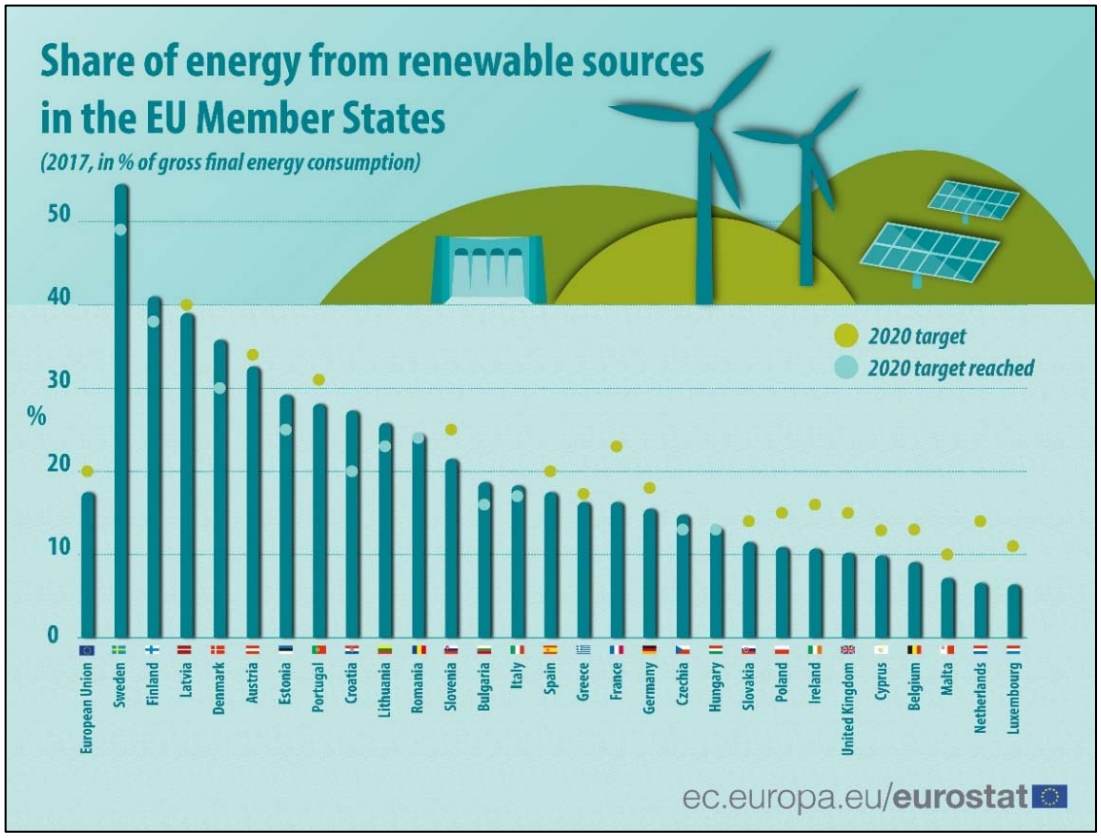

Plate 2-1 Share of energy from renewable sources, 2004 and 2016 - (Source: https://ec.europa.eu/eurostat/statistics-explained/images/b/b4/Share_of_energy_from_renewable_sources_2017_infograph.png)

It is estimated that 1 MW of wind capacity can provide enough electricity to supply approximately 730 homes. EirGrid in their '*Annual Renewable Energy Constraint & Curtailment Report 2017*' published in June 2018 stated that the amount of wind energy installed in the island of Ireland at the end of 2017 had reached 3,311 Megawatts (MW). More recently, 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 Capacity Statement also notes 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. In this context, the importance of wind energy becomes more apparent as it is estimated that 1 MW of wind capacity can provide enough electricity to supply approximately 650 homes.

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*".

It is noted that the full impact of the demand from data centres may be underestimated in the EirGrid Generation Capacity Statement as it is understood that only the data centres with signed connection agreements have been considered in the report. There are other data centre projects which have made connection enquiries with EirGrid estimated at more than 1,000 MVA, that are in the planning process and well advanced however they have not been included in this demand forecast. 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.

2.2.2.3 National Energy Projections – SEAI 2019

The SEAI National Energy Projections 2019 (May 2019) details that in 2005, 5% of Ireland's energy came from renewable sources, 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.

In the context of climate change the report states 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. The report also notes that as per the latest EirGrid Generation Capacity Statement there is a prediction of an increase of demand in the short term with 3% to 5% per year listed.

The Report states that 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 off shore 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.
- 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."*

It is noted under the strategy 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 Information and Communication Technology ('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.

- 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.

2.2.2.4 Energy in Ireland – SEAI Report 2019

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 CO2 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 – Ireland's 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.

2.2.2.5 Renewable Energy in Ireland 2020 Update – SEAI Update 2020

The SEAI's Renewable Energy in Ireland 2020 Update was published in April 2020. Section 5.2 of the report details the most recent updates with regards to wind energy, it is noted that the total electrical output from wind in 2018 (not normalised) was 8,640GWh. This was an overall increase of 16% when compared to 2017 figures. In 2018 it was found that energy generated by wind accounted for 28% of the gross electrical consumption, this was second to only natural gas.

Plate 2-2 below depicts the annual growth in installed wind-generation capacity and overall cumulative capacity since 2000. It should be highlighted that in 2018 258MW of wind capacity was installed within Ireland, furthermore an additional 461MW was installed in 2019 bringing the total installed capacity to 4,137MW.

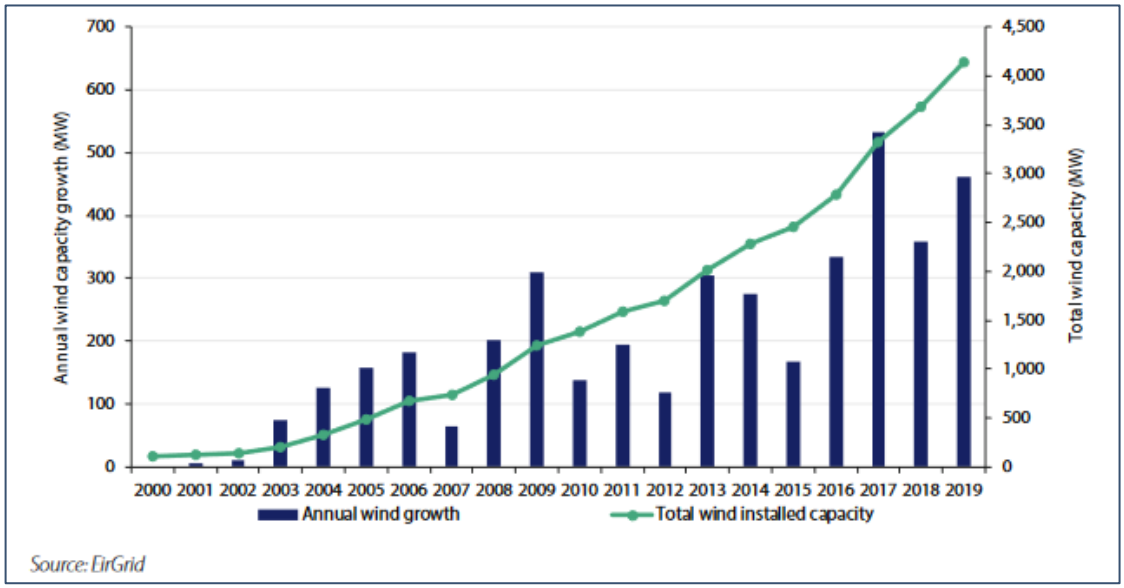

Plate 2-2: Installed Wind Generation Capacity 2000-2019

In relation to renewable electricity as is depicted in Plate 2-3 below Ireland was 12th out of the EU-28 at 33.2%, above the EU-28 average of 32.1%. The report notes that the top performing countries tend to have large hydropower resources, including Austria and Sweden. Furthermore, it is noted that Ireland had the second highest share of wind-generated electricity in 2018 at 28.1%.

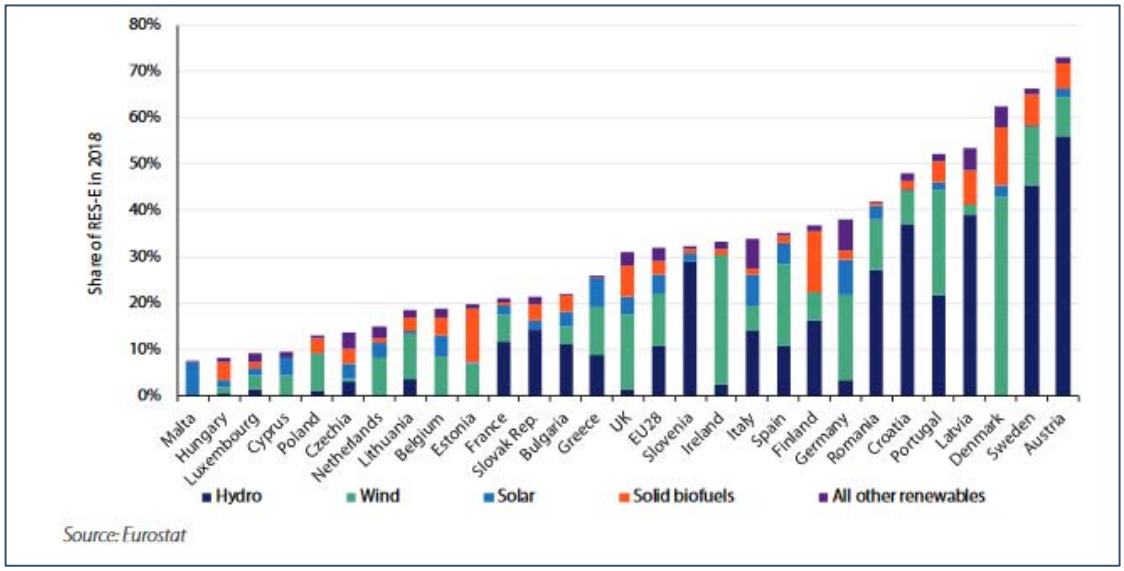

Plate 2-3: Renewable Electricity Share in 2018 for EU Member States

Notwithstanding the above the report acknowledges that Ireland is not on track to meet its 2020 renewable energy targets, and overall Ireland has made the second lowest progress to meeting the overall Renewable Energy Share (RES) target of all EU states. The share of renewable electricity (RES-E) was 33.2% in 2018, Ireland has a national target of 40% by 2020.

2.2.2.6 All-Island Generation Capacity Statement 2020-2029 - EirGrid

The All-Island Generation Capacity Statement 2020-2029 was published by Eir Grid in August 2020. Within the key message of the statement it is highlighted that the overall demand is set to increase and is forecast to increase significantly due to the expansion of large energy users including data centres. In Ireland, the growth in electricity demand for the next ten years varies between 33% in the median demand scenario, to 50% in the high scenario. The Median Forecast is generally aligned with EirGrid's Tomorrow Energy Scenarios which predict an overall Energy Requirement for Ireland of approximately 41TWh by 2030

The statement notes that within the Republic of Ireland new wind farms commissioned in 2019 brought the total wind capacity to 4,127 MW contributing to the increase in overall RES-E percentage to 35.7%. The Statement goes on to noted that:

> *"It can be assumed that Ireland's renewable targets will be achieved largely through the deployment of additional wind powered generation."*

Furthermore it is noted that the installed wind capacity within Ireland has increased from 135MW to over 4127MW between 2002 and 2019, this value is set to further increase as Ireland endeavours to meet its renewable targets.

2.2.3 National Policy

2.2.3.1 Introduction

This section provides a breakdown of national energy policy with regards to the proposed development with regards to the following:

- Ireland's Energy Policy Framework 2007-2020
- National Renewable Energy Action Plan
- Strategy for Renewable Energy 2012-2020
- White Paper on Energy Policy in Ireland 2015-2030
- Ireland's Transition to a Low Carbon Energy Future 2015-2030
- Electricity Support Schemes: I-SEM Arrangements Decision Paper, 2017
- Draft National Energy & Climate Plan 2021-2030
- Renewable Electricity Support Scheme RESS 2020, February 2020

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.

2.2.3.2 Delivering a Sustainable Energy Future for Ireland: The Energy Policy Framework 2007-2020

A 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. In 2014, 85% of Irish energy requirements are imported. Combined with our peripheral location, this reality 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 as set out in the Paper are security of supply, environmental sustainability and economic competitiveness.

The Energy Policy Framework 2007 – 2020 sets out clear actions, targets and timeframes for meeting these interlinked objectives.

European Union Directive 2009/28/EC 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 2017, wind energy accounted for 84% of normalised renewable electricity *('Renewable Energy in Ireland 2019 Report', Sustainable Energy Authority of Ireland'*, 2019).

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."*

2.2.3.3 National Renewable Energy Action Plan 2010

Article 4 of Directive 2009/28/EC on the promotion of the use of energy from renewable sources 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.

Ireland's National Renewable Energy Action Plan (NREAP) sets out the Government's strategic approach and planned measures to deliver on Ireland's 16% target under Directive 2009/28/EC. In relation to wind energy, the NREAP states:

> *"It is noted that as a country, 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."*

2.2.3.4 Strategy for Renewable Energy 2012-2020

The Government's Strategy for Renewable Energy 2012 – 2020 was published by the Department of Communications, Energy and Natural Resources in May 2012. It acknowledges the national importance of developing renewable energy and confirms the Government's commitment to this.

The Strategy sets out 5 no. 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 and have the possibility of connecting to wider markets via the existing and planned interconnectors to the UK and France. Key actions arising from the Strategy included;

"Commission the East West Interconnector in 2012 and continue the necessary analysis to inform decisions on next interconnection priorities with UK and France."

Indeed the All-Island Generation Capacity Statement 2019-2028 (Eirgrid/SONI) highlights that amongst the pathways to achieving the 2030 EU RES-E targets of up to 70% includethe enhancement of interconnections, including the Celtic interconnector to France and further interconnection to the UK.

In order to achieve Strategic Goal 1 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".

2.2.3.5 The White Paper - Ireland's Transition to a Low Carbon Energy Future 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.

The White Paper entitled *'Ireland's Transition to a Low Carbon Energy Future 2015-2030',* published in December 2015 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 White Paper states that onshore wind continues to be the main contributor of renewable energy, - 18.2% of total generation and 81% of renewable electricity (RES-E) in 2014. The impacts of 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 states that mean annual temperatures in Ireland have risen by 0.7 º Celsius (C) over the past century. Mean temperatures in Ireland relative to the 1961 to 1990 averages are likely to rise by 1.8 to 4.0º C by the 2050s and by in excess of 2ºC by the end of the century due to climate change.

The policy framework sets out a vision for a low carbon future that maintains Ireland's competitiveness and ensures a supply of affordable energy. 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 the White Paper the Department confirmed that onshore wind is the cheapest form of renewable energy in Ireland:

> *(Onshore Wind) "is a proven technology and Ireland's abundant wind resources means that a wind generator in Ireland generates more electricity than similar installations in other countries. This results in a lower cost of support."*

2.2.3.6 Electricity Support Schemes – I-SEM Arrangements Decision Paper 2017

The Department of Communications, Climate Action and Environment (DCCAE) has updated its existing electricity support schemes supported by the Public Service Obligation (PSO) Levy (primarily for renewable energy). In May 2017, DCCAE published an information paper which outlined a number of options being considered as part of this decision-making process and set out the Department's emerging thinking on the optimal outcome. Having sought stakeholder views in relation to the options being considered (as set out in the May 2017 document) and drawing on the supporting analysis provided by the EirGrid modelling, the DCCAE published its final decisions on these matters in June 2018. The three published decisions are set out below, however, it should be noted that the DCCAE has reserved the right to periodically review the impact of the decisions.

- Decision 1: The market revenue calculation for the purposes of calculating the PSO levy for supported wind generation (Alternative Energy Requirement (AER), Renewable Energy Feed In Tariff (REFIT) 1 and 2) will be amended to adapt to the Integrated Single Electricity Market (ISEM). The market revenue calculation for wind generators will, for the energy component, be based on the lower of a blend of 80% of the Day Ahead Market Price and 20% of the Balancing Market Price, and the Day Ahead Market Price for all supported wind generators above 5MW capacity. For supported wind generators below 5 MW, the market revenue calculation will, for the energy component, be based on the lower of a blend of 70% of the Day Ahead Market Price and 30% of the Balancing Market Price, and the Day Ahead Market Price.

- Decision 2: The market revenue calculation for the purposes of calculating the PSO levy for other supported generation (under REFIT 1, REFIT 2, REFIT 3 and the Peat PSO Scheme) will be amended to adapt to the Integrated Single Electricity Market. For these generators (peat, hydro and biomass) supported under the PSO levy, the market revenue calculation for the energy component will be based on the Day Ahead Market Price.

- Decision 3: The market revenue calculations for the purposes of calculating the PSO levy for all supported generation will take into account only capacity market revenues and not capacity market costs.

In summary, at national level it is clear that there remains ongoing promotion of the use of energy from renewable sources in line with EU Directives. Furthermore, Ireland's wind resource is expected to play a pivotal role in this. As such, the proposed development will directly contribute to these policy targets and requirements.

2.2.3.7 Draft National Energy and Climate Plan (NECP) 2021-2030, December 2018

The Draft National Energy & Climate Plan (NECP) 2021-2023 was published by the Government of Ireland in December 2018. The NECP has been prepared in accordance with the Governance of the Energy Union and Climate Action Regulation. This first draft takes into account energy and climate policies developed to date, the levels of demographic and economic growth identified in the Project 2040 process and includes all of the climate and energy measures set out in the National Development Plan 2018-2027.

The NECP sets out how EU Countries (including Ireland) intend to address energy and climate related issues:

- energy efficiency
- renewables
- greenhouse gas
- emissions reductions
- interconnections
- research and innovation

Furthermore, a progress report must be prepared by each country within the EU every 2 years. The consultation period for the NECP closed in February 2019, it was expected that a final version of the NECP was to be submitted in December 2019 however it appears that this deadline has been missed.

2.2.3.8 Renewable Electricity Support Scheme RESS 2020, February 2020

The Climate Action Plan (June 2019) sets out actions across every sector which will ensure Ireland meets its future climate commitments. A key part of the Plan is a move to 70% renewable electricity by 2030, a measure which will be driven by the introduction of the Renewable Electricity Support Scheme ('RESS').

The RESS is an auction-based scheme which invites renewable electricity projects to bid for capacity and receive a guaranteed price for the electricity they generate. The Terms and Conditions for the first competition (RESS 1:2020) was published in February 2020 and will provide support to renewable electricity projects in Ireland. The RESS will deliver, amongst other policy objectives:

> *"An ambitious renewable electricity policy to 2030 increasing energy security, energy sustainability and ensuring the cost effectiveness of energy policy"*

The RESS has been designed to deliver on a broader range of policy objectives including:

- the provision of pathways and supports for communities to participate directly in renewable energy projects
- broadening the renewable electricity technology mix (the diversity of technologies);and
- increasing energy security, energy sustainability and ensuring the cost effectiveness of energy policy.

The first auction is expected to deliver up to an increase of 3,000GWh in renewable electricity generation by the end of 2022.

The Scheme will provide for a renewable electricity (RES-E) ambition of up to 70% by 2030, subject to determining the cost-effective level which will be set out in the draft National Energy and Climate Plan (NECP).

The preliminary results of the RESS 1 auction were published on the 4th of August 2020, EirGrid ran the auction in on the 28th of July 2020 and of the 108 projects who submitted an offer price, 82 projects have been deemed to be provisionally successful while 26 were considered to be unsuccessful. The successful projects constitute a mix of on-shore wind and solar.

The Auction Scheme and the ECP framework has now been established and is operational and will facilitate and provide a pathway to realise the for renewable electricity (RES-E) ambition of up to 70% by 2030, that has been established.

The first auction is expected to deliver up to an increase of 3,000GWh in renewable electricity generation by the end of 2022.

2.2.3.9 Commission for Regulation of Utilities: Enduring Connection Policy

The Commission for Regulation of Utilities (CRU) launched a new grid connection policy in March 2018 for renewable and other generators, known as the Enduring Connection Policy (ECP-1), which sought 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 facilitate greater opportunities for advanced projects to connect to the network in addition to the preparing for future, more regular batches for connection.

The CRU announced the launch of ECP2 in June of 2020, under ECP2 the following timelines have been set:

- ECP-2.1 applications in September 2020
- ECP-2.2 applications in September 2021
- ECP-2.3applications in September 2022

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

While community -led projects do not require planning permission to be in place to apply for ECP-2, in order to receive a connection offer planning permission will have to be in place.

With the ECP2 rule set now published and with a timeline set for the next three rounds of applications there is a clear pathway for the Slieveacurry Project to secure a grid connection in a timely manner, subject to receipt of planning permission.

2.2.4 Summary

Ireland faces significant challenges to meet its current 2020 targets, EU targets for renewable energy by 2030, and its commitment to transition to a low carbon economy by 2050. It is now clear that Ireland is unlikely to meet its 2020 target (all predictions and modelling point towards this fact albeit that no data analysis is yet available for 2020) as well as the longer-term movement away from fossil fuels. Furthermore, the severity of the situation was highlighted by the Irish Government, who, in 2019 declared a climate emergency. The proposed Cahermurphy Two Wind Farm will help Ireland address these challenges as well as addressing the country's over-dependence on imported fossil fuels.

2.3 Climate Change Policy and Targets

2.3.1 Introduction

This section of the EIAR presents the various policies and targets which relate to climate change. Climate change in the context of EU and national policy is considered over the subsections outlined below:

- Impacts on Climate Change
- International Policy
  - United Nations Framework Convention on Climate Change
- Kyoto Protocol Targets
  - Doha Amendment to the Kyoto Protocol;
  - COP21 Paris Agreement;
  - COP25 Madrid- Current Progress;
  - 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;
  - 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 stresses the importance of reducing global warming. The context of international policy has altered over the last 30 years from being of a warning nature to the current almost universally accepted belief that we are in a climate crisis. The 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.

2.3.2 Impacts of 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 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 1.8°C by the 2050's and by more than 2°C by the end of the century due to climate change.

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. It notes that:

"Barriers to this, both scientific and socio-economic, are required to be identified and addressed in order that Ireland can be optimally positioned to thrive in a changing world."

The report discusses the impacts of climate change in terms of water resource management, agriculture and biodiversity, as described below.

2.3.3 International Policy

2.3.3.1 United Nations Framework Convention on Climate Change

In 1992, countries joined an international treaty, the United Nations Framework Convention on Climate Change (UNFCCC), as a framework for international efforts to combat the challenge posed by climate change. 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.

Ireland is a Party to the Kyoto Protocol, which is a protocol to the UNFCCC. The Kyoto Protocol is 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. Further details on Ireland's obligations under the Kyoto Protocol are presented below.

2.3.3.2 Kyoto Protocol Targets

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.

2.3.3.2.1 *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 5% against 1990 levels. During the second commitment period, thirty-seven 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.

2.3.3.2.2 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 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 Agreement 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. It is balanced as regards adaptation and mitigation, and durable, with a periodical ratcheting-up of ambitions.

An article published by the IPCC (Intergovernmental Panel on Climate Change) on the 6th October 2018 titled 'Global Warming of 1.5oC'. The article details 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 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.

2.3.3.2.3 COP25 Madrid– Current Progress

COP25, the 25th session of the COP, was held between the 2nd and 13th of December 2019 in Madrid. The conference was characterised by repeated warnings from civil society (NGOs and corporates) on emerging evidence and scientific consensus on climate change risk. Specifically, it is noted that there are only '10 years left' before the opportunity of limiting global warming to 1.5°C is no long feasible. As such, the only scenario that makes it possible is a '7.6% reduction of global GHG emissions every year between 2020 and 2030, and to reach net zero emissions by 2050'. However, there was no consensus achieved between States to finalise the operating rules of the Paris Agreement and ensure that it became operational by 2020. Three issues which emerged between States from the COP25 are summarised below:

- There was no uniform consensus between States to raise countries' climate ambitions, e.g. to make increased commitments in light of growing climate change data. Some States were opposed to imposing any obligation on countries to submit enhanced pledges next year, arguing it should be each country's own decision. All states must submit a review of their commitments for COP 26 in 2020. At the current level of climate targets, within a decade, the objective of the Paris Agreement will no longer be achievable.
- There was no agreement on finalising Article 6, the foundations for international cooperation to combat climate change. The aim was to establish the rules for new international mechanisms for financing and transferring GHG emission reductions;
- There was no agreement on financing (Green Climate Fund); specifically, relating to both loss and damage caused by climate change.
- Despite the lack of consensus to the above challenges, the COP25 did achieve more limited success in the introduction of the "*San Jose Principles for High Ambition and Integrity of International Carbon Markets",* which sets out the framework on which a robust carbon market should be built. These 12 no. principles include, but are not limited to:
    - Ensures environmental integrity and enables the highest possible mitigation ambition;

- Dlivers an overall mitigation in global emissions, moving beyond zero-sum offsetting approaches to help accelerate the reduction of global greenhouse gas emissions;
- Prohibits the use of pre-2020 units, Kyoto units and allowances, and any underlying reductions toward Paris Agreement and other international goals; and
- Ensures that double counting is avoided and that all use of markets toward international climate goals is subject to corresponding adjustments.

These principles were supported by 23 EU, including Ireland, and Latin American countries, 5 pacific islands and 2 countries in the Caribbean.

In addition, the European Union's Green Pact was introduced on the 11th of December with agreement of the European Council and all Member States (except Poland)on the ambition of climate neutrality in 2050, supported by a financing plan of €1,000 billion over 10 years.

2.3.3.2.4 Progress on Targets

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 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 (http://ec.europa.eu/eurostat/statistics-explained/index.php/Europe_2020_indicators_-_climate_change_and_energy) 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 (CO2) 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.

While the EU as a whole is projected to exceed its 2020 target of reducing GHG emissions by 20%. 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."*

2.3.3.2.5 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 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 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 emissions increasing from current levels by 1% and 6% by 2020 and 2030, respectively, under the '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 CO2 (metric tonnes of Carbon Dioxide) under the *"With Existing Measures"* scenario and 9.2 Mt CO2 under the "With Additional Measures" scenario.

2.3.4 National Climate Change Policy

2.3.4.1 National Climate Change Adaption 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 (see Section 2.3.4.3) puts the development of National Climate Change Adaptation Frameworks and Sectoral Adaptation Plans on a statutory basis.

The Climate Action and Low Carbon Development Act 2015 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.

Following approval of the statutory National Adaptation Framework, Section 6 of the Act requires the Government to request all relevant Government Ministers to prepare sectoral adaptation plans covering the relevant sectors under their remit within a specified period. The National Adaptation Framework Plan was published on the 19th January 2018 and is discussed below at Section 2.3.4.4.

2.3.4.2 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.

2.3.4.3 Climate Action and Low Carbon Development Act 2015

The Climate Action and Low Carbon Development Act 2015 was signed into law on 10th December 2015. The Climate Action and Low Carbon Act 2015 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.

2.3.4.4 National Adaptation Framework – Planning for a Climate Resilient Ireland 2018

Ireland's first statutory National Adaptation Framework ('NAF") was published in 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 and strategies in relation to climate change.

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 sets out a summary of observed and projected climate change impacts in Ireland, progress to date in terms of climate adaption and sets out a number of guiding principles for adaption at national level.

Chapter 1 of the NAF 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 Key Messages are set out in 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.*
- *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."*

The Framework quotes the Intergovernmental Panel on Climate Change (IPCC, 2013) in which it was concluded that there is 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.

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. Chapter 3 of the framework includes the guiding principles for adaptation, 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. The NAF states 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. As noted earlier, Section 2.3.5.3 of this Chapter sets out Clare County Council's Climate Adaptation Strategy.

The Framework sets out the key sectors concerned in developing sectoral adaptation plans, and includes electricity and gas networks. Building capacity within the sectors to cope with climate change should be a key focus area of emerging sectoral plans.

2.3.4.5 Report of the Joint Committee on Climate Action Climate Change, 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:

- A target of net zero economy-wide Green House Gas (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;
- 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 Irelands targets.

Chapter 7 of the report outlines the committee's recommendations for developing Irelands capacity in renewable energies and renewable electricity in particular. It is noted that the transformation of Irelands 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.

2.3.4.6 Climate Action Plan 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.

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 have 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; and
- Changes in the distribution and time of lifecycle events of plant and animal species on land and in the oceans.

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.

Chapter 7 of the CAP details the plans surrounding electricity. Within Ireland electricity accounting for 19.3% of Irelands greenhouse gases in 2017, the following is noted:

> *"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 2017 within Ireland 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. It is expected that demand for electricity is forecast to increase by 50% above existing capacity in the next decade. Generation electricity builds of a renewable nature rather than fossil fuels has been marked as essential.

The CAP goes on to note that with regards to policy measures to date that they 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 the following targets have been set out to meet the required level of emissions by 2030:

- *"Reduce CO^2 eq. emissions from the sector by 50–55% relative to 2030 Pre-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*
  - ***up to 8.2 GW total of increased onshore wind capacity***
- *Meet 15% of electricity demand by renewable sources contracted under Corporate PPAs"* (emphasis added).

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. 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 CAP presents clear and unequivocal support for the provision of additional renewable energy generation, and presents yet further policy support for increased wind energy.

The proposed Wind Farm is in line with the overall provisions of the CAP. The generation of renewable energy from onshore wind will directly assist in Ireland meeting its binding target, specifically the stated target of 8.2GW total of increased onshore wind capacity. Furthermore, the proposed development will contribute in the following:

- Aid in the decarbonisation of the energy system (Target- Reduce CO2 eq. emissions from the sector by 50–55% relative to 2030).
- The proposed development can contribute toward achieving 70% renewable electricity by 2030.
- The proposal will reinforce grid infrastructure and interconnection across the grid.

2.3.5 Strategic Planning Policy Context

2.3.5.1 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
  - Regional Policy - Regional Spatial and Economic Strategy, Southern Region 2020
- Local Policy
  - Clare County Development Plan 2017-2023 (as varied)

- Material Considerations
  - Interim Guidelines for Planning Authorities on Statutory Plans, Renewable Energy and Climate Change 2017
  - DoEHLG Wind Energy Guidelines 2006
  - Draft Revised Wind Energy Development Guidelines 2019
  - Department Circular PL5/2017
  - 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
  - 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.

2.3.5.1.1 The National Planning Framework: Project Ireland 2040 (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 and supersedes the National Spatial Strategy 2002-2020 ('NSS').

The NPF notes that while the overall quality of the country's environment is good it is not without challenges. The NPF notes that the manner in which we plan for potential issues is important in the context of sustainability of our environment.

> *"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."*

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
- Managing Waste

The NPF notes that the population of Ireland is projected to increase by approximately 1 million people by 2040 and that 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.*"

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 National Planning Framework 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.

The NPF highlights that Ireland's national energy policy is focused on three pillars: (1) sustainability, (2) security of supply and (3) competitiveness. Furthermore it is noted that *"The Government recognise that Ireland must reduce greenhouse gas emissions from the energy sector by at least 80% by 2050, compared to 1990 levels, while at the same time ensuring security of supply of competitive energy sources to our citizens and businesses.*" The NPF notes that our transition to a low carbon energy future requires:

- 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, smartgrids, 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 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. National Policy Objective 55 of the NPF specifically relates to renewable energy, stating it is an objective 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".*

National Strategic Outcome 8-Transition to a Low Carbon and Climate Resilient Society aims to *"Deliver 40% of our electricity needs from renewable sources by 2020 with a strategic aim to increase renewable deployment in line with EU targets and national policy objectives out of 2030 and beyond."*

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.

2.3.5.1.2 *Draft Renewable Electricity Policy and Development Framework (DCCAE)*

No draft Frameowrk has been published to date. However, associated documentation published to date indicates that the Draft Renewable Electricity Policy and Development Framework is being 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.

The most recent publicly circulated documentation in relation to the REPDF (July 2018) 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.

2.3.5.2 Regional Policy

2.3.5.2.1 *Regional Spatial and Economic Strategy for the Southern Region, 2020*

The Regional Spatial and Economic Strategy for the Southern Region 2020 ('RSES') was formally adopted on the 31st January 2020. The RSES supports the development of measures to address the sectors outlined in Project Ireland 2040 Investment in the Transition to a Low Carbon Society 2018 – 2027. The RSES acknowledges that actions will be required across several sectors to assist the transition, including (inter alia) Renewable Energy and Energy Efficiency.

In relation to the decarbonisation of electricity to achieve targets, the RSES acknowledges that this "*will require investment in measures to develop alternative renewable energies with greater interconnection to energy resources, increased capacity in biomass/biofuels and reconfiguration of power generation facilities from use of fossil fuels to low carbon technical solutions.*"

Regional decarbonisation is supported in the RSES through Regional Policy Objective ('RPO') 90 which aims to develop a Regional Decarbonisation Plan which will *"provide a framework for action on de-carbonisation across all sectors".*

Other the RPOs of relevance with regards the development proposal are::

- RPO 09: Holistic Approach to Delivering Infrastructure
  - *"It is an objective to ensure investment and delivery of comprehensive infrastructure packages to meet growth targets that prioritise the delivery of compact growth and sustainable mobility as per the NPF objectives including: Water services, digital, green infrastructure, transport and sustainable travel, community and social, renewable energy, recreation, open space amenity, climate change adaptation and future proofing infrastructure including flood risk management measures, environmental improvement, arts, culture and public realm."*

- RPO 56: Low Carbon Economy
  - *"a.The RSES recognises the urgency to transition to a low carbon future and it is therefore an objective to accelerate the transition towards low carbon economy and circular economy through mechanisms such as the Climate Action Competitive Fund;*
  - *b. It is an objective to develop enterprises that create and employ green technologies.*
  - *c. Local Authorities shall ensure that the development of green industry and technologies incorporates careful consideration of potential environmental impacts at project level including the capacity of receiving environment and existing infrastructure to serve new industries.*
  - *d. Local Authorities shall include objectives in statutory land use plans to promote energy conservation, energy efficiency and the use of renewable energy sources in existing building stock, including retro fitting of energy efficiency measures in the existing building stock, energy efficiency in traditional buildings and initiatives to achieve Nearly Zero-Energy Buildings (NZEB) standards in line with the Energy Performance of Buildings Directive (EPBD)*
  - *e. It is an objective to support investments in energy efficiency of existing commercial and public building stock with a target of all public buildings and at least one-third of total commercial premises upgraded to BER Rating 'B'. Local Authorities shall report annually on energy usage in all public buildings and will achieve a target of 33% improvement in energy efficiency in all buildings in accordance with the National Energy Efficiency Action Plan (NEEAP)."*

- RPO 87: Low Carbon Energy Future
  - *"The RSES is committed to the implementation of the Government's policy under Ireland's Transition to a Low Carbon Energy Future 2015-2030 and Climate Action Plan 2019. The RSES is committed to the implementation of the Government's policy under Ireland's Transition to a Low Carbon Energy Future 2015-30 and Climate Action Plan 2019. It is an objective to promote change across business, public and residential sectors to achieve reduced GHG emissions in accordance with current and future national targets, improve energy efficiency and increase the use of renewable energy sources across the key sectors of electricity supply, heating, transport and agriculture."*

- RPO 95: Sustainable Renewable Energy Generation
  - *"It is an objective to support implementation of the National Renewable Energy Action Plan (NREAP), and the Offshore Renewable Energy Plan and the implementation of mitigation measures outlined in their respective SEA and AA and leverage the Region as a leader and innovator in sustainable renewable energy generation."*

- RPO 96: Integrating Renewable Energy Sources
  - *"It is an objective to support the sustainable development, maintenance and upgrading of electricity and gas network grid infrastructure to integrate renewable energy sources and*

ensure our national and regional energy system remains safe, secure and ready to meet increased demand as the regional economy grows."

- RPO 98: Regional Renewable Energy Strategy
  - *"It is an objective to support the development of a Regional Renewable Energy Strategy with relevant stakeholders."*

- RPO 99: Renewable Wind Energy
  - *It is an objective to support the sustainable development of renewable wind energy (on shore and offshore) at appropriate locations and related grid infrastructure in the Southern Region in compliance with national Wind Energy Guidelines."*

- RPO 100: Indigenous Renewable Energy Production and Grid Injection
  - *It is an objective to support the integration of indigenous renewable energy production and grid injection*

- RPO 221: Renewable Energy Generation and Transmission Network
  - *"a. Local Authority City and County Development Plans shall support the sustainable development of renewable energy generation and demand centres such as data centres which can be serviced with a renewable energy source (subject to appropriate environmental assessment and the planning process) to spatially suitable locations to ensure efficient use of the existing transmission network;*
  - *b. The RSES supports strengthened and sustainable local/community renewable energy networks, micro renewable generation, climate smart countryside projects and connections from such initiatives to the grid. The potential for sustainable local/community energy projects and micro generation to both mitigate climate change and to reduce fuel poverty is also supported;*
  - *c. The RSES supports the Southern Region as a Carbon Neutral Energy Region."*

2.3.5.3 Local Policy

2.3.5.3.1 *Clare County Development Plan 2017-2023 (as varied)*

In relation to energy, the Clare County Development Plan 2017 – 2023 ('CDP') recognises that an attractive environment for industry and therefore investment depends on the areas ability to deliver "*a competitive and uninterrupted energy supply*." A strategic plan-led approach has been employed in the CDP via the Clare Renewable Energy Strategy ('RES') in relation to renewable energy production. The Development Plan also includes a dedicated Wind Energy Strategy ('WES'). Both are presented in the context of what is a supportive overarching policy framework within the Development Plan.

Development Plan Policy CDP18.1 Climate Change has the following objectives:

A. "To support the implementation of the Limerick Clare Climate Change Strategy 2006, and any subsequent versions of the Strategy;
B. To facilitate measures which seek to reduce emissions of greenhouse gases;
C. To adopt sustainable planning strategies through integrating land use and transportation and by facilitating mixed use developments as a means of reducing greenhouse emissions;
D. To raise awareness and understanding of the impacts of climate change on both the local economy and communities in the County."

Policy CDP6.17: Energy Supply of the Development Plan states:

"It is an objective of the Development Plan: To contribute to the economic development and enhanced employment opportunities in the County by:

A. *Facilitating the development of a self-sustaining, secure, reliable and efficient renewable energy supply and storage for the County;*
B. *Enabling the County to become a leader in the production of sustainable and renewable energy for national and international consumption through research, technology development and innovation."*

Policy CDP6.18: Green Technology supports the "*development of low carbon and green tech businesses and industries throughout the County."*

Development Plan Policy CDP8.40: Renewable Energy states:

"It is an objective of the Development Plan:

A. *To encourage and to favourably consider proposals for renewable energy developments and ancillary facilities in order to meet national, regional and County renewable energy targets, and to facilitate a reduction in CO2 emissions and the promotion of a low carbon economy;*
B. *To assess future renewable energy-related development proposals having regard to the Clare Renewable Energy Strategy 2017-2023;*
C. *To assess proposals for wind energy development and associated infrastructure having regard to the Clare Wind Energy Strategy and the associated SEA and AA, or any subsequent updated adopted strategy;*
D. *To prepare an updated Wind Energy Strategy for County Clare during the lifetime of this Development Plan;*
E. *To strike an appropriate balance between facilitating renewable and wind energy-related development and protecting the residential amenities of neighbouring properties;*
F. *To support and facilitate the development of new alternatives and technological advances in relation to renewable energy production and storage, that may emerge over the lifetime of this Plan;*
G. *To ensure that all proposals for renewable energy developments and ancillary facilities in the County are in full compliance with the requirements of the SEA and Habitats Directives and Objective CDP2.1;*
H. *To promote and market the County as a leader of renewable energy provision;*
I. *To support the implementation of 'Ireland's Transition to a Low Carbon Energy Economy 2015-2030'.*

Associated Policy CDP 10.11: Renewable Energy Development states:

> *"It is an objective of the Development Plan: To facilitate the development of renewable energy developments in rural areas in accordance with the adopted Clare Wind Energy Strategy and Renewable Energy Strategy and the associated SEA and NIR (and any subsequent strategies)."*

The Plan is clear regarding the importance of wind energy in the Plan area. It states that the county "*has one of the best wind resources in the world – almost the entire county has either an excellent or very good wind energy resource*." It also recognises however that wind energy development must be balanced against potential impacts on landscape, ecology and amenities of local communities.

Volume 5 of the Development Plan contains the Clare Wind Energy Strategy ('WES'). The Strategy (CWES) divides County Clare into four areas with regard to their capacity to accommodate wind energy developments on the basis of the County Landscape Character Assessment. The majority of the proposed development site is situated within an area designated as a '**Strategic Area'** for Wind Farm Development. One turbine falls within an area designated as '**Acceptable in Principle'**.

The WES defines these areas as follows:

- Strategic Areas (WES Eight): "*These key areas are considered to be eminently suitable for wind farm development and are of strategic importance because of;*

- *Good / excellent wind resources Access to grid*
- *Distance from properties and*
- *Outside any Natura 2000 sites Projects within these areas must:*
- *Demonstrate conformity with existing and approved wind farms to avoid visual clutter. Be designed and developed in line with the Wind Energy Development Guidelines, Guidelines for Planning Authorities (DoEHLG, 2006) in terms of siting, layout and environmental studies.*
- *Provide a Habitats Directive Assessment under Article 6 of the Habitat Regulations if the site is located in close proximity to a Special Area of Conservation or Special Protection Area.*
- *Be developed in a comprehensive manner avoiding the piecemeal development of the areas designated as 'strategic'.*

Target wind energy generation from strategic areas is 400MW"

- Acceptable in Principle (WES 9) : "*These areas are considered suitable for wind farm development because of:*
  - *Sufficient wind speeds,*
  - *Access to grid network, and*
  - *Established patterns of inquiries.*

  Projects within these areas must:
  - *Demonstrate conformity with existing and approved wind farms to avoid visual clutter. Designed and developed in line with the Planning Guidelines in terms of siting, layout and environmental studies.*
  - *Provide a Habitats Directive Assessment under Article 6 of the Habitat Regulations if situated in proximity to a Special Area of Conservation or Special Protection Area will require. [sic]*

  Target wind energy generation from Acceptable in Principle areas is 150 MW"

As discussed in detail in various chapters of this EIAR the location of the proposed development is considered acceptable under the terms of WES 8 and 9, as noted above.

The target contained in WES 8 is of note – it sets a target of 400 MW of wind energy generation to come from Strategic Areas. To-date, only 144.78MW of wind energy projects have been permitted or constructed in the areas designated as Strategic Areas. The proposed development, in seeking to locate nine of the ten proposed turbines in Strategic Areas, would further deliver on the stated target on the CWES by delivering a further 11%MW (approximately) of the County's target for Strategic Areas.

Similarly, WES 9 includes a target of 150 MW of wind energy generation from Acceptable In Principle areas. To-date, only 99.7MW of wind energy projects have been permitted or constructed in the areas designated as Acceptable in Principle Areas. The proposed development, in seeking to locate one of the ten proposed turbines in Acceptable in Principle Areas, would further deliver on the stated target on the CWES by delivering a further 3.2% of the County's target for Acceptable in Principle Areas.

A series of dedicated wind energy development objectives are set out in the WES, which offer further support for wind energy development. These are listed below:

- WES One: Development of Renewable Energy Generation- "*It is the objective of the Council to support, in principle and in appropriate scales and locations, the development of wind energy resources in County Clare. It is an objective of the Council to ensure the security of energy supply by accommodating the development of wind energy resources in appropriate areas and at appropriate scales within the County.*

- WES Two: Development of Low Carbon Economy "*County Clare will seek to promote itself as moving towards becoming a low carbon County by 2017 as a means of attracting inward investment to the County and the wider Mid-West region."*

- WES Three: County Partnership Approach- "*Clare County Council will seek to promote wind energy in appropriate sites in the County and will work with agencies such as the Clare County Development Board, Clare Enterprise Board, Limerick Clare Energy Agency, Shannon Development, I.D.A and Enterprise Ireland to encourage investment in research and technology associated with wind farms and other renewable energy technology.*"

- WES Four: Response to National Policy – "*The White Paper on Energy has set a target of 40% of electricity to be generated from renewable sources by 2020. In the Mid-West Regional Climate Change Strategy, County Clare is identified as having a potential 600MW energy produced from renewables by 2020. Clare County Council will aim to achieve a minimum target of 550MW from wind energy by the conclusion of this Strategy.*"

- WES Five: "Promotion of Community Involvement- *Clare County Council will seek to promote community involvement and require community benefit where possible in Wind farm developments.*"

- WES Six: Infrastructure Development Proposals "*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 policy, legislation and environmental considerations.*"

- WES Seven: Natura 2000 Sites- *"Having regard to the provisions of the Habitats Directive 92/43/EEC, where a proposed development will give rise to significant adverse direct, indirect or secondary impacts on Natura 2000 sites, (either individually or in combination with other plans or projects), permission will only be granted where there is no alternative solution and where there are imperative reasons of overriding public interest in favour of granting permission, including those of a social or economic nature".*

It should be noted that in relation to WES Four above, the Strategy outlines that the County exceeded the 2005 target of 50MW by achieving 101.4MW permitted capacity. Taking the recent target for a 70% share of renewable electricity in the Climate Action Plan 2019 and the shortfall found in respect of targets contained in WES 8 and WES 9 noted earlier, it will be necessary to increase the installed renewable generation capacity throughout the Country and Clare will have to meet the local targets which will follow.

The RES aims to, in conjunction with the Development Plan, *"position the County as the national leader in renewable energy generation, supporting energy efficiency and conservation, with an accessible modern telecommunications infrastructure, achieving balanced social and economic development and assisting Ireland's Green Energy target.*"

The RES notes that "*energy needs in County Clare are expected to rise by 2020...*" This is balanced against a recognition that "*the County has considerable capacity to produce energy from renewable and indigenous resources.*" Policy RES 2.1 of the Strategy is that "*it is an objective of Clare County Council to meet the County's energy needs from 100% indigenous renewable energy sources.*"

The proposed development will directly assist in meeting the areas energy needs should it be consented by delivering approximately 48MW of renewable energy.

The objectives for Strategic Areas and Acceptable in Principle areas set out in the RES (complementing that of the WES) are:

*"The objective for the **Strategic Areas** (WES8) states that these areas are eminently suitable for wind farm development and notes their good/excellent wind resource, access to grid, distance from properties and location outside designated sites. A target of 400MW from these areas is identified. WES8 outlines key issues as being compliance with the D. o E. Wind Energy Guidelines, comprehensive development of the strategic areas, environmental protection and avoidance of visual clutter".*

*"The objective for the **Acceptable in Principle** areas (WES9) states that these areas are considered suitable for wind farm development and notes their sufficient wind speeds, access to grid and established patterns of inquiries. A target of 150MW from these areas is identified. WES9 outlines key issues as being compliance with the D. o E. Wind Energy Guidelines, environmental protection and avoidance of visual clutter"*

Development Plan Policy CDP13.1 Landscape Character Assessment states that it is an objective of Clare County Council "*To encourage the utilisation of the Landscape Character Assessment of County Clare and other relevant landscape policy and guidelines and to have regard to them in the management, enhancement and promotion of the landscapes of County Clare."*

The Plan contains three landscape designations – Heritage Landscape, Working Landscape and Settled Landscapes – with the subject site being located in a **Settled Landscape**. Policy CDP13.2 Settled Landscapes strives for a balance to be achieved between residential amenity and economic activity in such areas. The Policy states:

"To permit development in areas designated as 'settled landscapes' that sustain and enhance quality of life and residential amenity and promote economic activity subject to:

- *Conformity with all other relevant provisions of the Plan and the availability and protection of resources;*
- *Selection of appropriate sites in the first instance within this landscape, together with consideration of the details of siting and design which are directed towards minimising visual impacts;*
- *Regard being given to avoiding intrusions on scenic routes and on ridges or shorelines.*

Developments in these areas will be required to demonstrate:

- *That the site has been selected to avoid visually prominent locations;*
- *That the site layouts avail of existing topography and vegetation to reduce visibility from scenic routes, walking trails, water bodies, public amenities and roads;*
- *That design for buildings and structures reduce visual impact through careful choice of forms, finishes and colours, and that any site works seek to reduce visual impact."*

An iterative design process has been undertaken in respect of the development informed by the Development Plan and Wind Energy Strategy for the county, early-stage impact assessment work, landscape modelling, zone of theoretical visibility (ZTV) mapping and photomontage preparation to ensure the optimum design for the project with respect to landscape and visual factors has been proposed.

Other Development Plan Policies which are of relevance include those relating to Appropriate Assessment, Strategic Environmental Assessment and Strategic Flood Risk Assessment. These are dealt with in CDP2.1 which notes that it is an objective of the Development Plan:

A. *"To require the preparation and assessment of all planning applications in the Plan area to have regard to the information, data and requirements of the Natura Impact Report, SEA Environmental Report and Strategic Flood Risk Assessment Report contained in Volume 10 of this Development Plan;*

B. *To require projects to be fully informed by ecological and environmental constraints at the earliest stage of project planning and any necessary assessment to be undertaken, including assessments of disturbance to species, where required;*
C. *To require compliance with the objectives and requirements of the Habitats Directive, the Bird Directive, Water Framework Directive, all other relevant EU Directives and all relevant transposing legislation."*

Development CDP14.2 in relation to European Sites is also relevant. It states that it is an objective of the Development Plan:

A. *"To afford the highest level of protection to all designated European sites in accordance with the relevant Directives and legislation on such matters;*
B. *To require all planning applications for development that may have (or cannot rule out) likely significant effects on European sites in view of the site's Conservation Objectives, either in isolation or in combination with other plans or projects, to submit a Natura Impact Statement in accordance with the requirements of the EU Habitats Directive and the Planning and Development Act, 2000 (as amended);*
C. *To recognise and afford appropriate protection to any new or modified SPAs or SACs that are identified during the lifetime of this Plan, having regard to the fact that proposals for development outside of a European site may also have an indirect effect."*

Development Plan Policy CDP14.1: Biodiversity states that it is an objective of the Council:

A. *"To implement the County Clare Heritage Plan 2011-2017 and the Clare Biodiversity Action Plan 2014-2017, or any subsequent plans, in partnership with all relevant stakeholders;*
B. *To review the Clare County Heritage Plan 2011-2017 and to prepare a new Plan, which will be set within the context of the National Heritage Plan, upon the expiry of the existing adopted Plan;*
C. *To support National Biodiversity Week and events such as Bioblitz in order to increase awareness of biodiversity and its benefits to the community;*
D. *To ensure that features of importance to local biodiversity are retained as part of developments and projects being undertaken in the County;*
E. *To identify ecological buffer spaces/zones, where appropriate, in the Plan area"*

The EIAR has fully considered the policies above and has undertaken Appropriate Assessment screening, with a Natura Impact Statement ('NIS') being prepared. Consideration of features of importance have also informed constraints exercises and the design iteration process.

In relation to woodlands, trees and hedgerows, the high amenity value of woodlands is recognised in the Plan. Some of the proposed wind farm site is occupied by commercial forestry. As part of the Proposed Development, tree felling will be required within and around the development footprint to allow the construction of turbine bases, access roads and the other ancillary infrastructure. With that in mind, Policy CDP14.17 Woodlands, Trees and Hedgerows states that it is an objective of Clare County Council to (inter alia):

- *"To preserve and conserve individual or groups of trees identified in Volume 2 of this Plan as 'Trees for Preservation' which will enhance the character and appearance of an area;*
- *To protect individual or groups of trees within the Plan area which are important for environmental, recreational, historical, biodiversity and/or aesthetic reasons or by reason of contribution to sense of place, including groups of trees which correspond with protected habitats, or which support protected species, under the Habitats Directive;*
- *To work with landowners, local communities and other relevant groups to promote the retention and conservation of existing trees and hedgerows and encourage*

development proposals that enhance the landscape through positive management and additional planting/sensitive replanting of native tree species;

- *To protect woodlands and hedgerows from damage and/or degradation and to prevent disruption of the connectivity of woodlands and hedgerows of the County;*
- *To ensure, where required, applications for development include proposals for planting / leave a suitable ecological buffer zone, between the development works and areas/features of ecological importance;*
- *To require, where possible, that all trees felled as a result of development proposals be replaced at a minimum ratio of 10 new native species per 1 tree felled."*

The site of the proposed wind farm and along the route of the grid connection was originally planted as a commercial crop and will be felled in the future should the proposed wind farm proceed or not.

A small proportion of the commercial crop (34.11ha) will be felled to accommodate the wind farm development. This includes a total of 27.6 hectares within and around the footprint of the Proposed Development and 6.51 hectares along the grid connection route. A total area of approximately 34.11 hectares of commercial forestry will require replanting elsewhere in the State and this forms part of the project for assessment. Details regarding the area to be felled are outlined in Chapter 4: Section 4.3.10 of this EIAR.

The Forest Service policy on the granting of felling licences requires replanting of forestry on a hectare-by-hectare basis. Four potential replanting areas have been identified for assessment purposes, with an availability of 36.72 hectares, located in Brackloon, Co. Roscommon, Cooraclare, Co. Clare, Pollnabrone, Co. Galway and Stranamart, Co. Cavan. These lands have been granted Forest Service Technical Approval for afforestation, and this or similarly approved land will be used for replanting should the proposed development receive planning permission.

2.3.6 Other Material Considerations

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

In July 2017, the Department of Housing, Planning and Local Government (DoHPLG) 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 s.28 in the performance of their functions under the Planning and Development Acts 2000-2018.

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."

2.3.6.2 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 reaffirms 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:

1. 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;
2. 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;
3. The elimination of shadow flicker; and
4. 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 PL5/2017 and the Interim Guidelines confirms that the DoEHLG Wind Energy Guidelines 2006 continue as the relevant guidelines until the publication of any updated guidelines.

2.3.6.3 DoEHLG Wind Energy Guidelines

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.

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 is continuing this review. Publication of elements of a "preferred draft approach" were

issued in June 2017. The four key aspects of the preferred draft approach have been set out previously in Section 2.3.6.2 above.

The '***Draft Revised Wind Energy Development Guidelines'*** (Department of Housing, Planning and Local Government, December 2019 were published for public consultation on the 12th December 2019. That consultation ended on the 19th February 2020. The draft Guidelines Methodologies are intended to ensure "*a consistency of approach throughout the country in the identification of suitable locations for wind energy development and the treatment of planning applications."*

The review of the 2006 Guidelines was undertaken to "*reflect technological developments in the wind energy sector and to strike a balance between the concerns of local communities and the need to invest in indigenous energy projects*."

The draft Guidelines consider the planning policy and legislative context of onshore wind turbine applications, considerations in the assessment of an application including aesthetic considerations in siting and design and planning conditions.

The EIAR is cognisant of the *Draft Revised Wind Energy Development Guidelines.* There is, at the time of writing, no timeframe associated with the formalization of the Guidelines.

2.3.6.4 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).

2.3.6.5 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 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 in Section 2.7.2 below.

2.3.6.6 DCCAE 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.

2.3.6.7 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 be carried out under the relevant guidance from the Forestry Service.

2.3.6.8 Clare County Climate Change Adaptation Strategy 2019-2024

This document states that "*Clare County Council fully supports the implementation of the 2016 Paris Agreement on Climate Change... The Local Authority is committed to working with the Climate Action Regional Office.*"

It is noted that the SEAI in their Annual Report 2018 on Public Sector Energy Efficiency Performance credited Clare with a 17.8% energy savings against its 2006-2008 energy usage baseline. The Strategy highlights that "*while this is more efficient than the original baseline, we are not yet on the path to meet the 2020 target.*" Specifically, the 'gap to the target energy performance' is set out as follows:

- *"The target energy consumption in 2020 is 15.671 GWh.*
- *An energy performance improvement of 18% is required for the period 2017 to 2020.*
- *An energy reduction of 3.56 GWh is required to achieve the performance improvement required."*

The Strategy highlights that public lighting represents 36% of all energy use which is to be further scrutinised to achieve energy savings.

The Strategy further notes that the Council have been actively targeting energy efficiency and increasing the renewable energy share of energy consumption via a range of measures, including: (inter alia)

- *Building fabric and heating system upgrades in buildings, offices, libraries, museum;*
- *Retrofits to local authority houses (over 900 to date) to achieve C3 minimum BER;*
- *Installation of biomass boilers & solar thermal heating panels in County Hall, Ennis;*
- *Installation of 5 Electric Vehicle (EV) charging points on local authority sites;*
- *Building Management System (BMS) at County Hall, Ennis.*

Amongst the listed adaptation objectives and actions of the Strategy is *"to promote County Clare as a low carbon county and support the development of low carbon and green technology businesses and industries throughout the county."* Proposed actions to achieve this objective include:

- "*Support on-land and off-shore renewable energy production by a range of appropriate technologies;*
- *As a means of de-carbonising the economic and social sectors, thus reducing greenhouse gases, we will support the increased use of renewable energy in the commercial and agricultural sectors."*

Following on from this, objective 4 of the Strategy is to specifically "*promote and facilitate the provision of high quality, secure, efficient and reliable renewable energy sources along with appropriate energy storage facilities in order to assist in the creation of a low carbon County Clare*." The actions listed associated with this specific objective include:

- *(a) Encourage proposals for renewable energy developments and ancillary facilities in order to meet national, regional and county renewable energy targets, and to facilitate a reduction in CO2 emissions and the promotion of a low carbon economy through Planning Policy and land use objectives.*
- *(b) Through land use policy and objectives, support and facilitate the development of new alternatives and technological advances in relation to renewable energy production and storage.*
- *(c) Support the implementation of the policy document 'Ireland's Transition to a Low Carbon Energy Economy 2015-2030'.*

Map Legend

- Permitted Slievecallan Wind Farm (29 Turbines)
- Permitted Cahermurphy Wind Farm (4 Turbines)
- Permitted Booltiagh Wind Farm (19 Turbines)
- Permitted Glenmore Wind Farm (12 Turbines)
- Permited Boolynagleragh Wind Farm (9 Turbines)
- Permitted Boolynagleragh Wind Farm Extension (7 Turbines)
- Permitted Letteragh Wind Farm (6 Turbines)
- Permitted Kiltumper Wind Farm (2 Turbines)
- Permitted Crossmore Wind Farm (7 Turbines)
- Coor Shanavogh Wind Farm -Under Appeal (6 Turbines)
- Proposed Cahermurphy Two Wind Farm (10 Turbines)
- Permitted Moanmore Wind Farm (7 Turbines)
- Permitted Tullabrack Wind Farm (6 Turbines)
- Permitted Moneypoint Wind Farm (5 Turbines)
- 20 km Buffer
- 5km Buffer

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Drawing Title
Wind Farms within 20km

Project Title
Cahermurphy Two Wind Farm

Drawn By	Checked By
Eoin O'Sullivan	Michael Watson
Project No. 170238	Drawing No. 2.1
Scale 1:150000	Date 18.08.20

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The Strategy supports and complements the Clare County Development Plan 2017-2023 (as varied) and reinforces the aim to position Clare as a leader in the development an efficient renewable energy supply and storage for the county. The generation of renewable energy from onshore wind will directly assist in Ireland meeting its binding target of 8.2GW total of increased onshore wind capacity. Furthermore, the proposed development will contribute to a reduction in CO2 emissions and will contribute toward achieving 70% renewable electricity by 2030.

2.4 Site of the Proposed Development

2.4.1 Site Location

The proposed wind farm site is located approximately 5 kilometres to the north of Kilmihil and 25 kilometres southwest of Ennis, Co. Clare. The Grid Reference co-ordinates for the approximate centre of the site are E 108,368, N 168,989.

2.4.2 Access

The site is accessed via local roads from the R484 Regional Road, which travels in a west-east direction between Doonbeg and Kilmihil and the R483 Regional Road, which travels in north-south direction between Creegh and Cooraclare. The site will use the same access route and same site entrance used by the existing Cahermurphy Wind Farm which was recently constructed in 2019. The interior of the site is served by a number of existing forest roads.

2.5 Planning History

A search of the online planning register has revealed that there have been no planning applications within the application boundary.

The wind farm applications set out in Table 2-1 below have occurred within a 20km radius of the proposed development site. This area and range of wind farm developments are those which have been considered to inform the Landsscpe and Visual Impact Assessment of the project as set out in Chapter 13 of this EIAR. The existing and permitted wind energy developments located within 20km of the Cahermurphy Two Wind Farm site are shown in Figure 2-1.

Table 2-1 Planning History – Wind Enenrgy Development Within 20km of the Wind Farm Site

Planning Ref.	Site Name	Summary Description	Decision
00/567	Booltiagh Wind Farm Extension	A wind farm of 26 wind turbines with towers not exceeding 60 metres in height and rotor diameter not exceeding 62 metres and ancillary equipment for generation of electricity and control building and monitoring mast. Located circa 6-8km to the east of the application site. Operational	Granted on Appeal ref: PL.03. 120616 08/03/2001

Planning Ref.	Site Name	Summary Description	Decision
00/952	Monamore Wind Farm	Seven turbines with a tip height of 98m, and all associated works. Located circa 12km to the south-west of the application site. Operational	Granted on Appeal ref: PL0.123292 19/11/2001
02/2228	Glenmore Wind Farm	For the construction of a wind farm consisting of 14 Wind turbines (75 metres hub height and 75 metres hub height and 80 metres rotor blade diameter), on-site tracks, sub station control compound, hard standing area and ancillary facilities and sub-terrain cabling Located circa 5-6km to the south-east of the application site. Later Amended consent at this location (Pl. Ref. 14/575 ; Partially Complete/ Under Construction	Granted by Clare County Council on the 29/06/2004
03/2071	Cahermurphy	To erect 6 No. 1 MW wind turbines, 1 No. 40m Wind Monitoring Mast (Temporary) Service roadways and control house	**Refused** by Clare County Council; Granted on appeal by An Bord Pleanála on the 23/07/2004, ABP ref: 205692
03/79	Hibernian Wind Power Limited	Nineteen wind turbines, each having a rated electrical output of approximately 2000 kilowatts, and all associated works. Each wind turbine will comprise a tower up to 67 metres high, with blade lengths of up to 40 metres. Located circa 12km east of the application site. Under construction under applications 09/479 and 13/681 – see below	Clare County Council granted permission on the 13/11/2003
03/80	Lissycasey Wind Farm	Ten wind turbines, each having a rated electrical output of approximately 2000 kilowatts, and all associated works. Each wind turbine will comprise a tower up to 67	Clare County Council and An Bord Pleanála

Planning Ref.	Site Name	Summary Description	Decision
		metres high, with blades of up to 40 metres length Located circa 4.5km south-east of the application site. Not constructed	granted permission on the 4/12/2003 EoD granted under 09/248 08/05/2009 now expired
07/2900	Booltiagh Wind Farm	Permission for the erection of six wind turbines with a total tip height of up to 120 metres and all ancillary equipment and works. Located circa 6-8km to the east of the application site. Operational	Granted 17/10/2008
08/1678	Booltiagh Wind Farm	For Modification of Condition 2 of permitted development P07/2900. Permission for an extension of the permitted lifetime of the six turbine wind farm and ancillary equipment to a twenty year operational lifetime from the date of commissioning. Located circa 6-8km to the east of the application site. Operational	Granted by Clare County Council on the 24/01/2009
09/123	Crossmore Wind Farm	A development of seven wind turbines with hub height of 80m and blade diameter of 90m, construction of access roads, substation and associated works. Located circa 9km to the south/south-west of the application site. Permitted ; not yet constructed	Granted, 22/11/2009; EoD granted 10/07/2019 (ref: 19/388)
09/248	Lisseycasey Wind Farm	Extension of Duration application Permission Expired	Granted, 08/05/2009. Now expired
09/358	Kiltumper Wind Farm	Two wind turbines with a hub height of 63m and rotor diameter of 70m, and all associated and ancillary works. Located to the south of the application site.	Granted on Appeal ref: PL03.234010 20/10/2010

Planning Ref.	Site Name	Summary Description	Decision
		Under Construction	
09/479	Boolynagleragh Wind Farm	11 wind turbines, with a hub height of up to 80m and blade length of up to 45m and all associated site infrastructure. Located circa 12km to the east of the application site. Operational	Granted on Appeal ref: PL03.236376 07/12/2010
09/828	Booltiagh Wind Farm	Two wind turbines with towers up to 80 metres in height and total tip height up to 115 metres and all ancillary works.	**Refused** by Clare County Council and An Bord Pleanála
10/9	Slieve Callan Wind Farm	The construction of a 29 turbine wind farm. turbines described as having a hub height of 80 metres and rotor diameter of 90 metres, and all associated site infrastructure works. Located circa 8-10km to the north/northeast of the application site. Operational	Granted on Appeal ref: Pl03.237524 on the 18/08/2011
10/64	Tullabrack Wind Farm	Six turbines with an overall height of up to 120.5m and all associated works. Located circa 12km to the south-west of the application site. Permitted; not yet constructed	Granted 17/06/2010
11/360 & PL03.239378	Letteragh Wind Farm	Six wind turbines, with a hub height of 85 metres and rotor diameter of 82 metres, and all ancillary works. Located circa 6km north-east of the application site. Operational	Clare County Council refused permission which was overturned and granted by An Bord Pleanála on 06/09/2011.
11/361 & Pl.03.239933	Letteragh Wind Farm	A development of six wind turbines (maximum hub height 90m, maximum blade diameter 93m), and all associated site infrastructure.	Granted 21/02/2013,

Planning Ref.	Site Name	Summary Description	Decision
		Located circa 9-11km to the east of the application site. Operational	
12/74	Moneypoint Genrating Station	Five turbines with a tip height of 125m, including all associated works. Located circa 18km to the south-west of the application site. Operational	Granted on Appeal ref: PL0.241624 on the 12/12/2013
13/122	Kilmihil Wind Farm	Thirteen wind turbines with an overall ground to blade tip height of up to 136.5 metres, substation and all associated works The proposed development will supersede Planning permission for wind farm previously granted under Pl. Ref. Nos 02/2228 and 09/438.	Clare County Council **Refused** Permission.
13/681	Boolynagleragh Wind Farm	Seven turbine extension to Boolynagleragh Wind Farm and all associated works Permitted turbines have an overall maximum height of up to 126 metres. Located circa 12km to the east of the application site. Operational	Granted on Appeal ref: PL03.244095 13/06/2016
14/309	Glenmore Wind Farm	Extend the Appropriate Period of Planning Permissions P02/2228 and P09/438 for the construction of Windfarm consisting of 11 turbines, access roads, cabling and substation compound Located circa 6.2km to the east of the application site. Not constructed.	EOD granted by Clare County Council 21.07.2014, expired 26/06/2017
14/551	Cahermurphy Wind Farm	A ten year planning permission to construct a 4 turbine wind farm and all associated infrastructure in the townland of Cahermurphy, Kilmihil. The permitted turbines are up to 131m in height. Located to the immediate east of the application site.	Granted on Appeal, ref: PL03.245189 28/07/2016

Planning Ref.	Site Name	Summary Description	Decision
		Phase 1 – 3 of 4 turbines constructed and operational	
14/575	Glenmore Wind Farm	Twelve turbine wind farm with a maximum overall blade tip height of up to 136.5m, and all associated works Located approximately 7km to the south-east of the application site. Under Construction	Granted on Appeal Ref: PL03.245392 24/10/2016
15/474	Tullabrack Wind Farm	Extend the Appropriate Period of a Planning Permission P10-64 for a 6 turbine wind farm overall height 120.5m substation and all associated works. Located circa 12km south-west of the application site Operational	Clare County Council granted permission 28.08.2015; extension until 17/07/2020
15/860	Brookfield Renewable Ireland Ltd	Wind farm comprising 11 no. turbines with a maximum tip height of up to 131m and associated turbine foundations, and all associated works. Located circa 10km east of the application site.	Granted by Clare County Council and **refused** by An Bord Pleanála 18/09/2018
18/830	Boolynagleragh Wind Farm	Relocation of 2 no. previously permitted wind turbines at Boolynagleragh Wind Farm (Clare County Council , Pl. Ref. 09-479, An Bord Pleanála PL.03.236376). Located circa 12km east of the application site. Under Construction	Clare County Council granted permission on the 21/01/2019
19/159	Mid Clare Renewable Energy DAC	Amendment to the previously permitted Wind Farm in the townland of Cahermurphy, Kilmihil, Co. Clare (Clare County Council Pl. Ref. P14-551, An Bord Pleanála PL03.245189) Amending the height of turbine no. 3 of the previously permitted Cahermurphy Wind Farm to a tip height of up to 150m (increase in tip height of 19m from the previously approved 131 m turbine) Permitted; not yet constructed	Clare County Council granted permission on 30/05/2019

Planning Ref.	Site Name	Summary Description	Decision
19/388	Crossmore Wind Farm	Extend the Appropriate Period of Planning Permission P09/123 for proposed development which will consist of Seven wind turbines with a hub height of 80m and blade diameter of 90m, construction of substation, access roads and associated works. Located circa 10km southeast of the application site. Permitted; not yet constructed	EOD granted by Clare County Council 10/07/2019; EOD expires 24/11/2024

A range of other energy related planning permissions exist in proximity to the proposed development site (i.e. within 2km). Due to the proximity of these permitted developments and the potential for cumulative impacts to arise during construction and operational periods, these are also considered within this EIAR. A 2km radius has been taken as this is considered to encompasss any potential sensitive receptors and potential cumulative projects in this category for operational and construction purposes for the project. Table 2-2 below lists the relevant energy infrastructure related projects within 2 km of the proposed development.

Table 2-2: Other Energy-Related Planning Applications Within 2km of Application Wind Farm Site

Planning Ref.	Summary Description	Decision
11/340	Permission to extend the lifetime of the existing electrical substation at Booltiagh from a planning lifetime of 20 years as granted under ABP Ref. 03 120616 to a permanent structure and the construction of a permanent extension to the existing electrical substation building as granted planning under ABP Ref. PL03120616. Operational	Granted by Clare County Council on the 31/07/2011
13/558	Revised electricity substation in the townland of Knockalassa. This application represents an amendment to the substation already granted permission under Pl. Ref. No. P10/9 (An Bord Pleanála Ref: PL03.237524) The revised substation/ layout includes 3 No. control buildings, associated electrical plant and equipment and ancillary works. Operational	Granted by Clare County Council on the 24/01/2014
14/545	To construct a new 38kV overhead line connecting the Boolynagleragh wind farm with the existing 110 kV substation at Booltiagh. The line will be approximately 7.1km long and is located in the townlands of Boolynagleragh, Letteragh, Lisroe, Boolyneaska and Booltiagh. The majority of the overhead line structures are wooden polesets; the two end masts are steel structures. All structures range in height from 10m to 18m Operational	Granted by Clare County Council on the 31/05/2015

Planning Ref.	Summary Description	Decision
14/761	For development at Booltiagh 110 kv electrical transformer station consisting of alterations and extension to the existing Booltiagh 110 kv station to include; extension of existing 110 kv bus-bar, installation of 2 no. 110/38 kv bunded transformers and associated 110 kv and 38 kv transformer bays and 2 no. Arc Suppression Coils; construction of single storey control building; installation of 1 no. 38kv/MV bunded transformer; 4 no. lightning monopoles 18 metres high; replacement 110kV over-head line end mast 15 metres high and all associated works. Constructed	Granted by Clare County Council on the 09/12/2015
16/1011	Refurbishment of the existing Moneypoint - Oldstreet 400 kV overhead line. Permitted	Granted by CCC on the 24/09/2017
17/348	Temporary meteorological mast for the purpose of collecting meteorological data at Slaghbooly, Co. Clare. No detail of compliance with pre-commencement conditions on file	Granted permission on the 03/07/2017. The decision was upheld by An Bord Pleanála on the 02/02/2018
17/703	Development of a quarry and all associated site development and infrastructure works and services. Operational	Granted by Clare County Council on the 18/03/2018
18/223	Battery storage compound adjacent to an existing 110KV electricity substation and all associated/ancillary works. Permitted	Granted by Clare County Council on the 16/06/2018
19/299	Construction of a battery storage compound adjacent to the existing Glenmore electricity substation and all ancillary site works. Permitted	Granted by Clare County Council on the 09/09/2019

Table 2-3 below lists non-renewable energy development – existing and approved projects as well as planning applications pending a decision - within 2km of turbine infrastructure. Here a 2km distance from wind turbine infrastructure has been considered for operational and construction purposes as a conservative buffer to identify potential sensitive receptors and cumulative projects in the non-renewable energy category of development/projects in the vicinity. Table 2-3 below lists these relevant projects.

Table 2-3: Non-Renewable Energy Developments Within 2km of Turbine Infrastructure

Planning Ref.	Summary Description	Decision
94/215	Construct an extension to existing dwelling house.	Granted by Clare County Council on the 08/06/1994
95/486	Construction of a dormer bungalow, private garage and septic tank.	Granted by Clare County Council on the 15/09/1995
95/846	Permission to construct a low power transposer station	Granted by Clare County Council on the 18/01/1995
03/2499	Dwelling house, septic tank and foul sewer treatment plant	Granted by Clare County Council on the 13/08/2004
04/2605	Retain existing dwelling house and site works as constructed	Granted by Clare County Council on the 30/04/2005
04/2729	Retain existing house, entrance and site works	Granted by Clare County Council on the 26/03/2005
05/152	Relocate water storage reservoir and ancillary works on site as granted previously under Planning Ref. P03/984	Granted by Clare County Council on the 05/05/2005
05/2227	Reconstruct the existing dwelling house and all associated site works	Granted by Clare County Council on the 22/06/2006
05/88	To construct a 3 bay slatted shed	Granted by Clare County Council on 02/07/2005
061753	The construction of seven detached dwellinghouses and all ancillary works	Granted by Clare County Council on the 28/02/2007
06/376	Dwelling house, garage and treatment unit, including all ancillary works for the development	Granted by Clare County Council on the 27/07/2006
06/587	Demolition of an existing stone outbuilding and steel haybarn, the extension and refurbishment of an existing cottage and all associated works	Granted by Clare County Council on the 12/06/2006
06/678	Dwelling house, septic tank and foul sewer treatment plant	Granted by Clare County Council on the 14/09/2006
06/786	Retention permission for an existing constructed septic tank, percolation area and to demolish original septic tank and soakpit	Granted by Clare County Council 02/07/2006
06/1053	Dormer residence, entrance, driveway, septic tank and percolation area and all associated site development works	Granted by Clare County Council on the 06/08/2006

Planning Ref.	Summary Description	Decision
06/2719	Extension to a dormer residence and all associated site development work	Granted by Clare County Council on the 03/05/2007
06/2854	Domestic garage	Granted by Clare County Council on the 08/03/2007
0/6842	Retention permission for alterations to existing dwellinghouse as granted under P01/964	Granted by Clare County Council 10/07/2006
07/235	Extension to dwelling house	Granted by Clare County Council on the 30/04/2007
07/867	Slatted house and ancillary site works	Granted by Clare County Council on the 24/06/2007
07/1810	Single storey pitched roof dwelling house and a single storey detached garage, to install a proprietary waste water treatment system and percolation area, and associated site works	Granted by Clare County Council on the 12/01/2008
07/2066	Demolition of existing dwelling and outbuilding and for permission to construct a dwelling house as a replacement for existing dwelling house and all ancillary works.	Granted by Clare County Council on the 21/01/2008
07/2698	Dwelling house, a sewage treatment plant and a private garage c/w ancillary site works	Refused by Clare County Council
07/2712	Permission to erect dwelling house, septic tank and foul sewer treatment plant.	Granted by Clare County Council on the 01/09/2008
08/341	Extension to dwelling house.	Granted by Clare County Council on the 01/06/2008
08/849	Dormer type dwelling, private garage, wastewater treatment system and entrance.	Granted by Clare County Council on the 17/08/2008
08/1701	Dwelling house, entrance, site boundaries and waste water treatment system	Refused by Clare County Council and An Bord Pleanála
08/1829	Dwelling house, a sewage treatment plant and a private garage c/w ancillary site works	Granted by Clare County Council on the 11/04/2009
09/438	Extend the Period of Validity of Planning Permission P02/2228 by 5 years.(Permission will cease to have effect on 28/06/2009)	EOD granted by Clare County Council

Planning Ref.	Summary Description	Decision
09/808	Dwelling house, garage, sewage treatment system and associated site works.	Granted by Clare County Council on the 22/10/2009
09/1128	Single storey bungalow and car garage with all associated site and development works	Granted by Clare County Council on the 12/06/2010
09/1264	Renovations to and extension of existing house and all associated works.	Granted by Clare County Council on the 14/03/2010
10/8003	For the Upgrading of Kilmaley/Inagh Group Water Treatment Plant.	Granted by Clare County Council on 12/08/2010
11/130	Retention of loft conversion and dormer windows as constructed together with ancillary site works.	Granted by Clare County Council on 14/05/2011
11/712	To construct an extension to existing rear extension, demolish existing rear extension, alter front elevation of existing dwelling, upgrade existing sewage treatment system and associated site works.	Granted by Clare County Council 26/03/2012
11/529	Dwelling house, sewage treatment plant, associated site works and connect to ancillary services.	Refused by Clare County Council
11/809	Dwelling house, sewage treatment plant, and associated site works	Granted by Clare County Council on the 05/05/2012
12/727	To Extend the Appropriate Period of Planning Permission P07/2066 for a single storey dwelling house.	EOD granted by Clare County Council
13/384	Retention of the fully serviced prefabricated classroom.	Granted by Clare County Council on the 11/10/2013
14/397	To de-commission the existing septic tank servicing the National School and to provide a new wastewater treatment system on site with all associated site works.	Granted by Clare County Council on the 16/10/2014
14/615	Upgrading (widening and strengthening) of the existing forestry tracks and all associated works which will provide an alternative means of access to facilitate the construction of the initial phase of the wind farm permitted Pl. Ref P10-9.	Granted by Clare County Council on the 12/01/2015
14/614	Electricity substation already granted permission under Pl. Ref. No P02-2228 (as extended by Pl.Ref's P09-438 or P14-309).	Granted by Clare County Council on the 12/06/2015

Planning Ref.	Summary Description	Decision
15/480	To construct a new dwelling house with all necessary ancillary services.	Granted by Clare County Council on 03/12/2015
16/510	Retention permission for an existing 18 metre lattice telecommunications support structure (previously granted permission under reference P09-963), carrying antennae and link dish, together with associated equipment units and fencing.	Granted by Clare County Council on the 08/09/2016
16/257	Slatted unit with an underground slurry storage tank for housing livestock.	Granted by Clare County Council on the 21/06/2016
16/1011	Works associated with the refurbishment of the existing Moneypoint - Oldstreet 400 kV overhead line and all associated works.	Granted by Clare County Council on the 24/09/2017
17/651	For development which will consist of an extension to the existing school, consisting of a classroom, toilets and a store room, cloak room and all ancillary site works.	Granted by Clare County Council on the 18/11/2017
17/703	Quarry and all associated site development and infrastructure works and services.	Granted by Clare County Council on the 18/03/2018
17/907	Construction of a temporary bell-mouth entrance to facilitate the occasional vehicular access from a future forestry road to a public road (western side) and associated works.	Granted by Clare County Council on the 25/02/2018
17/908	Construction of a temporary bell-mouth entrance to facilitate occasional vehicular access from a future forestry road to a public road (eastern side) and associated works.	Granted by Clare County Council on the 25/02/2018
18/555	For development which will consist of the installation of battery arrays located within container units a control building and transformer and all associated works.	Granted by Clare County Council on the 30/09/2018
18/930	Construction of ballroom/function room, leisure facility including restaurant; 53 dwellings for tourist accommodation; gatehouse; car parking. Dismantling and removal of existing marquee structure.	Granted by Clare County Council on the 09/10/2019
18/1038	Permanent health and safety sign including all ancillary site works.	Granted by Clare County Council on the 18/03/2019
191005	Retention of a private artist studio which replaced a derelict shed on the same site.	Refused by Clare County Council on 21/02/2020.

Planning Ref.	Summary Description	Decision
		Appealed to ABP(ref: 306930) - live
19/868	Permanent health and safety sign including all ancillary site works at the entrance to Glenmore Wind Farm.	Granted by Clare County Council on the 24/01/2020
19/869	Permanent health and safety sign including all ancillary site works, at the entrance to Glenmore Wind Farm.	Granted by Clare County Council on the 24/01/2020
20/264	To develop a new off road car parking facility and set down area with all necessary ancillary works.	pending

Finally, a review of all non-renewable energy related projects (existing and permitted) within 1km of the proposed cable route have been reviewed. The 1km distance from the proposed works along the grid connection route reflects a generous and conservative range in terms of identifying permissions which may have the potential for cumulative effects having regard to the nature of the grid connection works (i.e. underground cabling). Many of the noted applications relate to agricultural developments and/or single residential developments. Table 2-4 below lists those existing and approved projects as well as planning applications pending a decision identified within 1 km of the grid connection works.

Table 2-4: Non-Renewable Energy Related Planning Applications Within 1km of the Grid Cable Route

Planning Ref.	Summary Description	Decision
95/253	Permission to construct on a roof an extension to rear and side of home.	Granted by Clare County Council, 22/06/1995
03/2499	Dwelling house, septic tank and foul sewer treatment plant.	Granted by Clare County Council , 13/08/2004
04/182	To erect dwelling house, septic tank and foul sewer treatment plant.	Granted by Clare County Council, 21/06/204
05/2227	To reconstruct the existing dwelling house, this includes raising the dwelling to a storey and a half, the construction of a new roof, rear extension, sewerage treatment system and associated site works.	Granted by Clare County Council, 22/05/2006
06/1053	To construct a dormer residence, entrance, driveway, septic tank and percolation area and all associated site development works.	Granted by Clare County Council, 06/07/2006
07/1810	To construct a single storey pitched roof dwelling house and a single storey detached garage, to install a proprietary waste water treatment system and percolation area, and associated site works.	Granted by Clare County Council 04/12/2007
07/2712	Permission to erect dwelling house, septic tank and foul sewer treatment plant.	Granted by Clare County Council 01/08/2008

Planning Ref.	Summary Description	Decision
09/1264	For renovations to and extension of existing house by converting and exisitng outbuilding to living accommodation and linking it to the side of the existing house, construction of a new waste water treatment system with soil polishing filter and associated site works.	Granted by Clare County Council, 11/02/2010
10/1084	For the construction of a dwelling house, treatment unit, percolation area, entrance and all associated site works.	Granted by Clare County Council 09/08/2011 Third Party Appeal (PL03.239505) – Appeal successful and permission refused 05/06/2011
14/345	Change of use of an existing structure from a school to a dwelling house and for permission to provide a new entrance along with associated site works.	Granted by Clare County Council, 15/09/2015
17/678	To construct a new dwelling house, private garage, proprietary wastewater treatment system and new site entrance along with all associated site works.	Granted by Clare County Counil 27/10/2017

The above-noted have been considered within this EIAR and informed the various cumulative assessments as necessary in the relevant chapters.

2.6 Scoping and Consultations

MKO issued a Scoping Request to relevant parties in June 2019. The Scoping Document issued provided information on the topics below and is included in this EIAR at Appendix 2-1.

- Description of the Proposed Development Site, including Site Location and Access and Land-Use
- Designated Areas
- Landscape Policy
- Planning Context and Government Targets
- Site Selection and Design Process
- Constraints Mapping & Site Design
- Scope of the EIAR and Natura Impact Assessment

2.6.1 Scoping Replies

The consultees to whom the scoping report was sent and the responses received to date are summarised in Table 2-5 and presented in Appendix 2-1:

Table 2-5 Scoping Replies

Consultee	Scoping Response Date	Scoping Response
An Taisce	None received.	No response
Broadcasting Authority of Ireland	05.06.2019	The BAI confirmed by email that they are not aware of any issues from existing windfarms into existing FM (Frequency Modulation) networks. Also, the proposed windfarm is not located close to any existing or planned FM transmission sites.
Bat Conservation Ireland	None received	No response
BirdWatch Ireland	05.06.2019	Acknowledgement of receipt.
Commission for Regulation of Utilities	None response	No response
Clare County Council – Planning Department	30.07.2019	Advised that the EIAR must include the information required under paragraph 1 of schedule 6 of the Planning and Development Regulations 2001, as amended and the Authority further advised cognisance is taken of the following: 1. Take into consideration the potential for impacts on water quality and substrate condition in the context of the presence of freshwater pearl mussels within the Annageeragh and Creegh *Margaritifera* Sensitive Area; • This has been considered in the EIAR at Chapters 7 and 10. 2. All stages of the development should be considered in compiling information regarding the interaction of the development with surface water and groundwater. Impacts on downstream receptors shall be identified; • This has been considered in the EIAR at Chapters 7 and 10. 3. Given the concentration of windfarms within the area it is imperative that as part of the constraints study to inform the restrictions that 'avoidance of cumulative wind farm development' is given due consideration; • This has been considered in the EIAR at Chapters 3 and 13 4. The EIAR should take into account permitted dwellings that may not as yet be constructed; • This has been taken into account at Chapter 5 of the EIAR 5. A landslide susceptibility modelling exercise should be undertaken;

Consultee	Scoping Response Date	Scoping Response
		• Chapter 9 of the EIAR (and associated Appendix 9-1) includes a Peat Stability Assessment at Section 9.3.8. An analysis of peat sliding was carried out at all the main infrastructure locations across the wind farm site, the purpose of which was to determine the Factor of Safety (FoS) of the peat slopes. No peat failures/landslides are recorded on the wind farm site which suggests that site conditions do not pre-dispose themselves to failures/landslides. A walkover survey and peat probing of the grid connection route identified no peat stability issues and therefore there was no requirement to carryout detailed analysis. 6. Acoustics and vibration should be considered; • This has been considered at Chapter 12 of the EIAR 7. Noise should be assessed in the context of site preparation, ongoing operation and any restoration required; • This has been considered at Chapter 12 of the EIAR 8. The assessment of landscape and visual impacts will be critical given the concentration of windfarms surrounding the proposed site; • This has been considered at Chapter 13 of the EIAR 9. The Population and Human Health chapter should address the cumulative effect of such a high concentration of windfarms within this location; • This has been considered at Chapter 5 of the EIAR 10. The cumulative visual impact of an additional windfarm will need to take into consideration the degree of separation and similarity of design; • This has been considered at Chapter 13 of the EIAR 11. A description of 'reasonable alternatives' rather than an outline of main alternatives must be included. • This has been considered at Chapter 3 of the EIAR.
Clare County Council - Transportation and Infrastructure Department	13.06.2019	Acknowledgement of receipt. A number of bodies have been notified of the request.
Clare County Council – Environment Department	13.06.2019	Acknowledgement of receipt. A number of bodies have been notified of the request.
Clare County Council – Heritage Officer	13.06.2019	Acknowledgement of receipt. A number of bodies have been notified of the request.

Consultee	Scoping Response Date	Scoping Response
Shannon Airport	12.06.2019	The following requests were set out in the Airport's response: 1. The siting of wind turbines at this location may have implications for the operations of the communication, navigation and surveillance systems used by Air Traffic Control for the separation and safety of aircraft. The geographical siting of these turbines may also have implications for the flight paths of aircraft. 2. Regard must be had to the Irish Aviation Authority (IAA) Obstacles to Aircraft in Flight Order, 2002 (S.I. No. 14 of 2002), as amended, which specifies the criteria used to determine whether or not any object anywhere in the state is deemed to be an obstacle affecting aircraft operations. Also, in order to assure the safety and efficiency of aircraft operations in the vicinity of airports, the International Civil Aviation Organisation (ICAO) has defined a volume of air space above which new objects are not permitted to interfere. 3. It would also be best practice that all wind energy developers should seek the views of the Irish Aviation Authority (IAA) at the pre-planning stage of consultation, with details of locations and proposed heights of turbines, to ensure that proposed developments do not cause difficulties with air navigation safety. 4. In the event that any potential adverse effects relating to this wind turbine development were identified as part of the consultation process, Shannon Airport Authority DAC would fully support any submission from the IAA. 5. Finally, should planning permission be granted for this development in the future, we would ask that the planning authority stipulate the mandatory deployment of obstacle avoidance lighting on each individual wind turbine in the interests of flight safety. • The above points are noted. In the event of favourable consideration of the application aircraft hazard lighting will be provided as required.
Department of Agriculture, Food and the Marine	None received	No response
Department of Communications, Climate Action and the Environment	None received	No response

Consultee	Scoping Response Date	Scoping Response
Department of Defence	26.06.2019	1. Single turbines or turbines delineating corners of a windfarm should be illuminated by high intensity obstacles strobe lights (Red). 2. Obstruction lighting elsewhere in a windfarm 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 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 above points are noted. In the event of favourable consideration of the application aircraft hazard lighting will be provided as required .
Department of Transport, Tourism & Sport	None received	No response
Department of Culture, Heritage and the Gaeltacht	26.06.2019 and 19.07.2019	Archaeology - the EIAR should contain a detailed cultural heritage section that addresses all built heritage within the footprint of the proposed windfarm. All assessments should be carried out by suitably qualified and suitably experienced archaeological personnel engaged by the client/contractor. The DAU also made the following observations: 1. Site is within the Annageragh & Creegh River Freshwater Pearl Mussel catchments. 2. There are records of Hen Harrier breeding in the site. 3. The site contains suitable habitat for Curlew and Marsh Fritillary Butterfly. 4. The site contains peatland habitats, some of which may be Annex habitat. • Please refer to Chapter 7 of the EIAR, Flora and Fauna; Chapter 8 Ornithology; Chapter 10 Hydrology and Hydrogeology and Chapter 14 Cultural Heritage
Fáilte Ireland	01.07.2019	Provided a copy of the Guidelines for the treatment of tourism in an EIS, which they recommended be taken into account in preparing the EIAR.

Consultee	Scoping Response Date	Scoping Response
		• Please refer to Chapter 5 of the EIAR, Human Beings
Geological Survey of Ireland	None received.	No response
Health Service Executive	None received	No response
Iarnród Éireann	None received	No response
Inland Fisheries Ireland	None received	No response
Irish Aviation Authority	13.06.2019	The IAA requested the following in the event that a grant of planning permission is issued: 1. Agree an aeronautical obstacle warning light scheme for the wind farm development. 2. Provide as constructed coordinates 3. Notify the Authority of intention to commence crane operations. The above-noted information will be provided to the IAA should a positive decision on the application be forthcoming. • This is noted. Should planning permission be granted for the development the agent/applicant will liaise with the IAA accordingly.
Irish Peatland Conservation Council	None received.	No response.
Irish Red Grouse Association	None received	No response
Irish Raptor Study Group	None received	Requested not to be included in future scoping exercises.
Irish Water	None received	No response
Irish Wildlife Trust	None received	No response
Office of Public Works	None received	No response

Consultee	Scoping Response Date	Scoping Response
Sustainable Energy Authority of Ireland	None received	No response
The Heritage Council	None received	No response
Transport Infrastructure Ireland	18.06.2019	TII provided a copy of their standard recommendations.

2.7 Other Consultation

2.7.1 Telecommunications

As part of the early constraints study undertaken in the early design stages, telecommunications bodies were contacted, and the responses set out in Table 2-6 below received.

Table 2-6: Telecommunications Responses

Consultee	Date of response	Response received
Airspeed Communications	01.04.2019	Airspeed noted that they had one link in the area of the proposed development. In a further response from Airspeed, they noted that a clearance of 15 metres was to be maintained between the turbines and the Airspeed link.
BT Communications Ireland	28.02.2019	No impacts noted therefore no potential for adverse impacts to arise.
Commission for Communications Regulation	28.02.2019	Provided list of operators.
Eir	02.02.2019	One transmission links within the proposed Wind farm, that is just inside the area of risk. A buffer of 100meters radius away from transmission paths required. This buffer has been incorporated into the constraints mapping exercise at the start of the project.
EOBO Ltd	01.04.2019	No links in the area therefore no potential for adverse impacts to arise.
ESB Telecoms	29.05.2019	There is no impact on any part of the current microwave network nor our polling radio network.
Imagine Group	06.03.2019	No impacts therefore no potential for adverse impacts to arise.

Consultee	Date of response	Response received
Ripplecom	28.02.2019	No impacts noted therefore no potential for adverse impacts to arise.
RTE Transmission Network Ltd	28.02.2019	Telecoms links unaffected. Request protocol agreement regarding potential impacts on television viewers to the west and northeast. • This is a standard requirement, and should a favourable planning decision be made, the relevant protocol agreement will be provided.
Tetra Ireland Communications Ltd.	06.03.2019	No impact anticipated therefore no potential for adverse impacts to arise.
Three Ireland	None received	No response
Towercom	11.03.2019	No significant impact on sites therefore no potential for adverse impacts to arise.
Viatel Ireland Ltd	01.04.2019	No impact on the network therefore no potential for adverse impacts to arise.
Virgin Ireland Ltd	28.02.2019	No links in the area therefore no potential for adverse impacts to arise.
Vodafone Ireland Ltd	28.02.2019	No issues to note therefore no potential for adverse impacts to arise.

2.7.2 Community Engagement

Building on the experience of the Applicant in the Cahermurphy area and Coillte's experience having developed four wind farms in Ireland over the past decade from which it has learnt many valuable lessons in relation to working with local communities and the importance of including local people in decisions that affect them. In 2017, the Renewable Energy Team in Coillte undertook a review of the Coillte Community Engagement and embarked on the design of an enhanced approach with the support of AstonEco Management.

The key elements of this new approach are:

- Detailed and systematic engagement with close neighbours to the project from a very early stage of project design, where possible.
- Open, transparent dialogue and communications.
- Creating opportunities for open, two way dialogue on key issues.
- Involvement of the local community in the project design process.
- Empowering local communities to be part of project decisions that affect them.
- Ensuring that the local community have access to all relevant information as soon as it is available, in an understandable format.

The approach places a focus on the residents of dwellings within 2 km of the site as these people will be closest to the development.

In order to build better projects the Applicants recognise the imperative of enabling meaningful engagement between the project team and the local residents. This engagement has to go beyond simply information provision, and through open, transparent dialogue and the involvement of people in decisions that affect them, move towards a more collaborative approach to infrastructure design that has a National interest but a local impact.

While public information events would typically feature as part of the overall community engagement process, the impacts of the Covid-19 pandemic and associated restrictions have meant that such engagement requires to be undertaken in a socially distant manner giving upmost regard for public health.

As such, information since March 2020 has been distributed in leaflet form to inform of the project proposals, and seek feedback.

The information circulated discussed the need for onshore wind as part of the wider energy mix; the subject site and associated selection process; detail of the proposed development; and community benefits arising.

The information circulated to date has highlighted that once the application is lodged with the Authority, the period for public comments would open.

The associated Community Engagement Report has been included under Appendix 2-2 of this EIAR.

2.7.3 Pre-Planning Meetings

A pre-planning meeting was held with Clare County Council on the 2nd October 2019. The following were in attendance:

- Acting Senior Exeutive Planner – Clare County Council
- Executive Planner – Clare County Council
- Environmental Officer - Clare County Council
- Applicant Respresentatives –
  - Mid Clare Renewable Energy DAC (Applicant)
  - Gerard Hynes Coillte (Applicant)
- Planning Consultant - MKO
- Environmental Consultant - MKO

At this meeting the following items were discussed

- Site Selection
  - Development Plan provisions
  - Site Constraints
- Development Description, Design & Layout
  - Iterative design process
  - Discussion of Layout
- Planning Application Approach
  - EIA Requirements
  - Councils Scoping Response
- Environmental Impact Assessment Report (EIAR)
  - Introduction, Background, Alternatives, Description

- Population and Human Health, including Shadow Flicker
- Biodiversity, including Flora & Fauna and Ornithology
- Land, Soil, Water, Air & Climate
- Noise
- Landscape
- Cultural Heritage, Material Assets (incl. Roads) and Interactions

- Community Engagement

- Cumulative Projects
  - Wind farm applications in vicinity and their status

The Planning Authority acknowledged the site of the proposed development is within both a 'Strategic Area' and 'Acceptable in Principle' area for wind farm development and referenced the detailed scoping response that was issued previously. The Planning Authority also highlighted that any future application should give adequate consideration to cumulative impacts arising from the proposed development in combination with the permitted and proposed wind farms in the wider area.

2.8 Cumulative Impact Assessment

The EIAR Directive and associated guidance documents state that as well as considering any direct, 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 Directive also requires the cumulation of effects with other existing and/or approved projects, taking into account any existing environmental problems relating to areas of particular environmental importance likely to be affected or the use of natural resources. The description of affects should take into account the environmental protection objectives established at Union or Member State level which are relevant to the project. 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. To gather a comprehensive view of cumulative impacts on these environmental considerations and to inform the EIAR process being undertaken by the consenting authority, each relevant chapter within this EIAR includes a cumulative impact assessment where appropriate.

The potential for cumulative impacts arising from other projects has therefore been fully considered within this EIAR.

2.8.1 Methodology for Cumulative Assessment of Projects

The potential cumulative impact of the proposed wind farm development combined with the potential impact of other projects has been carried out with the purpose of identifying what influence the proposed development will have on the surrounding environment when considered collectively with approved and existing projects in the vicinity of the proposed site location.

The Cumulative Impact Assessments (CIA) of projects has three principle aims:

1. To establish the range and nature of existing and/or approved projects within the cumulative impact study area of the proposed development.
2. To summarise the relevant projects which have a potential to create cumulative impacts.
3. 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 the Cumulative Impact Assessments carried out within this EIAR was compiled in relation to the relevant projects within the vicinity of the proposed development from which there may be potential for cumulative impacts to arise. The material gathered comprised EIAR's(/EIS's), planning application details and planning drawings and served to identify past and future projects, their activities and their environmental impacts.

2.8.1.1 Projects Considered in Cumulative Assessment

The projects considered in relation to the potential for cumulative impacts and for which all relevant data was reviewed (e.g. individual EIS/EIAR's, layouts, drawings etc) include those listed previously above in Section 2.5 i.e. wind farms within 20 kilometres of the proposed development site; all other projects(i.e. agricultural, residential and other developments within approximately 2 kilometres of the site of the proposed wind turbines and all relevant associated works, and other developments within 1km of proposed underground cable connection works.

Other developments considered within the cumulative assessment include land uses and the categories of works listed below. This EIAR therefore considers the full range of projects that could potentially have a cumulative effect with the current proposed development.

Each environmental topic covered in this EIAR bases its cumulative impact assessment on the projects listed in Section 2.5 and land uses below, and identifies projects that hold the potential for cumulative interaction within the context of the proposed development and discards projects that will neither directly or indirectly contribute to cumulative impacts.

2.8.1.1.1 *Forestry and Replanting*

The proposed development site is partially used for commercial forestry. It is noted that all general forestry activity will be curtailed on the site during the construction of the proposed development. It is noted that all general forestry activity will be curtailed on the site during the construction of the proposed development. The potential for cumulative effects during the construction, operational and decommissioning phases of the proposed wind farm have therefore been assessed.

The Forest Service is responsible for ensuring the development of Forestry within Ireland occurs 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 be carried out under the relevant guidance and under licence from the Forestry Service and full details are set out in Section 4.3.10 of this EIAR.

2.8.1.1.2 *Other Wind Turbines*

There are a number of wind farms located within a 20-kilometre radius of the proposed development site, as identified previously in Section 2.5 ofthis Chapter. Any cumulative affects arising are considered in the relevant chapters of this EIAR.

2.8.1.1.3 *Other Developments/Land uses*

In preparing this EIAR the planning register has been reviewed and all relevant general development planning applications/permissions and projects in the vicinity of the proposed development have been noted and considered as well as other existing projects/development. As discussed previously the majority of applications in the vicinity relate to the provision and/or alteration of one-off rural housing and agriculture-related structures. These applications and land uses (which include those listed previously above in Section 2.4) have also been taken into 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.

Overall the proposed development has been designed to mitigate impacts on the environment, 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 5(1)(d) of Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification) as amended by Directive 2014/52/EU (the EIA Directive) requires that the Environmental Impact Assessment Report (EIAR) prepared by the developer contains *"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."*

Article 5(1)(f) of the EIA Directive requires that the EIAR contains *"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."*

Annex IV of the EIA Directive states that the information provided in an EIAR should include a *"description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects."*

This section of the EIAR contains a description of the reasonable alternatives that were studied by the developer, which are relevant to the proposed project and its specific characteristics, in terms of site location and other renewable energy technologies as well as site layout incorporating size and scale of the project, connection to the national grid 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. It provides an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects.

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.

Hierarchy

EIA is concerned with projects. The Environmental Protection Agency (EPA) guidelines 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.

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.

3.1.2 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' Option;
- Strategic Site Selection;
- Alternative Renewable Energy Technology;
- Alternative Turbine Numbers and Model;
- Alternative Layout and Design;
- Alternative Transport Route and Site Access; 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.

3.2 'Do-Nothing' Alternative

Annex 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 developing a renewable energy project at the proposed development site would be to leave the site as it is, with no changes made to the current land-use practices of low intensity agriculture, turbary and forestry. In doing so, the environmental effects in terms of emissions are likely to be neutral however, the opportunity to capture a significant part of Clare'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 would also be lost, and the local economy would continue to rely primarily on agriculture and commercial forestry as the main source of income. It is likely that the trends of population decline and rural deprivation that have been recorded within the Study Area would continue in the absence of investment, as discussed in Section 5 of this EIAR on Population and Human Health. Overall the potential impact of this is considered to be long term, negative and slight.

The existing commercial forestry works, turbary and agriculture land use can and will continue in conjunction with this proposed use of the site.

A comparison of the potential environmental effects of the 'Do-Nothing' Alternative when compared against the chosen option of developing a renewable energy project at this site are presented in Table 3-1 below.

Table 3-1 Comparison of environmental effects when compared against the chosen option (developing the proposed wind farm at this site)

Environmental Consideration	Do Nothing Alternative
Population & Human Health (incl. Shadow Flicker)	No increase in local employment and no long-term financial contributions towards the local community. No potential for shadow flicker to affect sensitive receptors.
Biodiversity & Ornithology	No habitat loss
Land, Soils & Geology	Neutral
Geotechnical	Neutral
Water	Neutral
Air & Climate	Will not provide the opportunity for an overall increase in air quality or reduction of greenhouse gasses. Will not assist in achieving the renewable energy targets set out in the Climate Action Plan.
Noise & Vibration	No potential for noise impacts on nearby sensitive receptors.
Landscape & Visual	Neutral
Cultural Heritage & Archaeology	No potential for impacts on unrecorded, subsurface archaeology.
Material Assets	Neutral

3.3 Strategic Site Selection

3.3.1 Project Site Requirements

The initial (agreed) criteria for site identification by MCRE and Coillte, as future co-development partners, was to identify one contiguous land block within a designated windfarm development area within Co. Clare capable of accommodating a medium to large number of wind turbines.

The rationale behind one large land block was to limit the geographical spread of turbines, consolidate on-site supporting infrastructure and minimise visual impact.

The potential land blocks emerged from this review are Area A, Area B and Area C. The locations are presented in Figure 3.1.

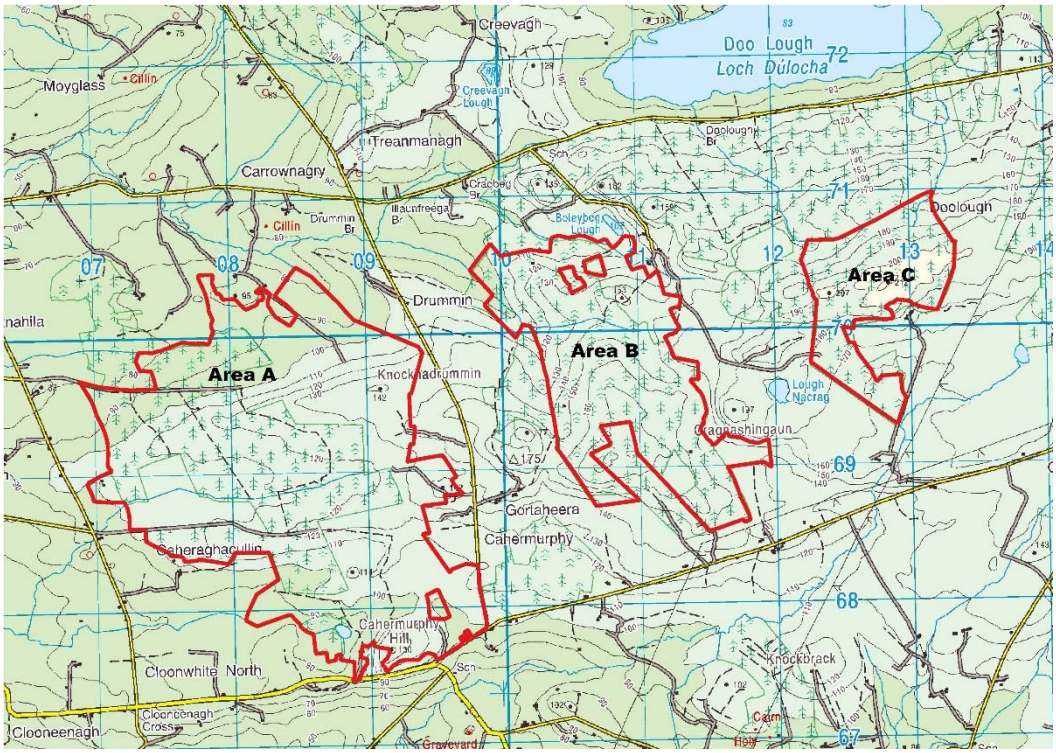


Figure 3.1 Areas A, B and C

3.3.1.1 Preliminary Constraints Mapping and Landscape Study

Constraints mapping and a Landscape Capacity Assessment (LCA) was carried out by MKO at the preliminary stage of the project (November 2018). The study examined Areas A, B and C with the view to accommodate a medium to large scale wind farm in County Clare.

Constraints mapping was initially carried out for the three areas. The constraints mapping process involved the placing of buffers around different types of constraints so as to identify clearly the areas within which no development works could take place. Please refer to Section 3.6.1 below for a description of the constraints and buffers applied. The constraints mapping indicated that a portion of Area C was within a buffer applied to a Hen Harrier nesting site. There was also a dwelling located adjacent to the eastern boundary of Area C. When these constraints, together with an applied wind take buffer of 240m were mapped, there was no remaining viable area for development within Area C.

Following the initial constraints study, only areas A and B were considered for assessment in the LCA. The study looked at a 10 no. turbine layout in Area A and a 4 no. turbine layout in Area B.

The LCA used a number of visualisation tools and techniques to gauge the capacity of the Cahermurphy landscape to absorb a wind farm and to determine the most appropriate spatial and vertical extent of wind turbines within each of the available lands.

The findings from the study indicated that the spatial extent of all 14 no. turbines was deemed acceptable within the landscape setting and due to the distance between the proposed development and existing and permitted turbines cumulative effects arising were not considered to be significant. In conclusion, the study found that the visual impact of a 14 no. turbine wind farm was acceptable with regard to the existing and permitted wind farms in the area.

Whilst it is noted that the findings from the LCA indicated that a 14 no. turbine wind farm was acceptable from a landscape and visual perspective, given the close proximity of the Hen Harrier territory at Doo Lough and the Cragnashingaun Bogs Natural Heritage Area, it was decided not to bring Area B forward for further consideration at this stage.

3.3.2 Suitability of the Candidate Site – Area A

The cost of building each megawatt (MW) of electricity-generating capacity in a wind farm is in the region of €1.8 million to €2.0 million. It is therefore critical for the applicants and their project team to ensure that the most suitable site for development of a proposed wind farm is identified and progressed through planning.

The site selection process for the current proposal has been fully informed by national, regional and local policy constraints at a macro level as well as site specific constraints that influence the turbine layout and project design on site at a micro level. The main policy, planning and environmental considerations for the selection of a potential wind farm site include:

- Site location relative to the Clare Wind Energy Strategy's classification of areas considered suitable for wind farm development from a planning policy perspective;
- Access to the national electricity grid possible within a viable distance;
- Located outside areas designated for protection of ecological species and habitats;
- Located predominantly within an existing commercial forestry which allows the site to take advantage of existing access roads;
- Sufficient area of unconstrained land in proximity to the permitted Cahermurphy wind farm site that could potentially accommodate wind farm development and turbine spacing requirements;
- Consistently high average annual wind speeds;
- Low population density; and
- Visual Amenity.

The criteria above will be explained further below in so far as they influenced the selection of Area A for development.

3.3.2.1 Clare Wind Energy Strategy

The Clare Wind Energy Strategy (WES) was adopted by Clare County Council as part of the Clare County Development Plan 2017– 2023.

> ***WES One*** ***Development of Renewable Energy Generation****: It is the objective of the Council to support, in principle and in appropriate scales and locations, the development of wind energy resources in County Clare. It is an objective of the Council to ensure the security of energy supply by accommodating the development of wind energy resources in appropriate areas and at appropriate scales within the County.*

WES Two ***Development of Low Carbon Economy****: County Clare will seek to promote itself as moving towards becoming a low carbon County by 2017 as a means of attracting inward investment to the County and wider Mid-West region.*

WES Three ***County Partnership Approach****: Clare County Council will seek to promote wind energy in appropriate sites in the County and will work with agencies such as the Clare County Development Board, Clare Enterprise Board, Limerick Clare Energy Agency, Shannon Development, I.D.A and Enterprise Ireland to encourage investment in research and technology associated with wind farms and other renewable energy technology.*

WES Four ***Response to National Policy****: The White Paper on Energy has set a target of 40% of electricity to be generate from renewable sources by 2020. In the Mid-West Regional Climate Change Strategy, County Clare is identified as having a potential 600MW energy produced from renewables by 2020. Clare County Council will aim to achieve a minimum target of 590 MW from wind energy by the conclusion of this Strategy.*

WES Five ***Promotion of Community Involvement****: Clare County Council will seek to promote community involvement and require community benefit where possible in Wind farm developments.*

WES Six ***Infrastructure Development Proposals:*** *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 policy, legislation and environmental considerations.*

WES Seven ***Natura 2000 Sites:*** *Having regard to the provisions of the Habitats Directive 92/43/EEC, where a proposed development will give rise to significant adverse direct, indirect or secondary impacts on Natura 2000 sites, (either individually or in combination with other plans or projects), permission will only be granted where there is no alternative solution and where there are imperative reasons of overriding public interest in favour of granting permission, including those of a social or economic nature.*

The WES categorises the County into four classes based on development potential for wind energy for the county as a whole and presented spatially. The classification hierarchy is set out as follows.

- Strategic Areas
- Acceptable in Principle
- Open to Consideration
- Not normally permissible

WES 8 *WES 8 establishes the criteria under which strategic areas are identified and mapped. These key areas are considered to be eminently suitable for wind farm development and are of strategic importance because of;*

- Good / excellent wind resources
- Access to grid
- Distance from properties and
- Outside any Natura 2000 sites

Projects within these areas must:

- Demonstrate conformity with existing and approved wind farms to avoid visual clutter.
- Be designed and developed in line with the Wind Energy Development Guidelines, Guidelines for Planning Authorities (DoEHLG, 2006) in terms of siting, layout and environmental studies.

- Provide a Habitats Directive Assessment under Article 6 of the Habitat Regulations if the site is located in close proximity to a Special Area of Conservation or Special Protection Area.
- Be developed in a comprehensive manner avoiding the piecemeal development of the areas designated as 'strategic'.

Target wind energy generation from areas classified as strategic areas is 400MW.

WES 9 *WES 9 establishes criteria under which areas deemed acceptable in principle to wind energy development are considered. These areas are considered suitable for wind farm development because of:*

- Sufficient wind speeds,
- Access to grid network, and
- Established patterns of inquiries.

Projects within these areas must:

- Demonstrate conformity with existing and approved wind farms to avoid visual clutter.
- Designed and developed in line with the Planning Guidelines in terms of siting, layout and environmental studies.
- Provide a Habitats Directive Assessment under Article 6 of the Habitat Regulations if situated in proximity to a Special Area of Conservation or Special Protection Area.

Target wind energy generation from Target wind from `Acceptable in Principle' areas is 150 MW.

The majority of the proposed Wind Farm site is located within an area designated as 'Strategic Areas' for wind energy development by the Wind Energy Strategy as part of Clare County Development Plan 2017-2023 and is therefore, the most suitable classification for development. A very small portion of the site is located within areas designated as "Acceptable In Principle". Please see Figure 3.2.

3.3.2.2 National Grid Connection

The proposed wind farm site is located within proximity of 2 no. existing electricity substations and therefore a wind energy development at this location has a number of options to enable connection to the national electricity grid. The existing Slievecallan 110 kV substation is located approximately 8 kilometres to the northeast of the site. The existing Booltiagh 110 kV substation is located approximately 7 kilometres to the southeast of the site.

3.3.2.3 Designated Sites

The proposed development site is not located within any area designated for ecological protection. The nearest Natura 2000 site, i.e. Special Area of Conservation (SAC) or Special Protection Area (SPA) is Mid-Clare Coast SPA and Carrowmore Point to Spanish Point and Islands SAC, the boundaries of which are located approximately 5.8 kilometres to the west of the site, at its nearest point. The nearest national designated site, i.e. Natural Heritage Area (NHA) or proposed Natural Heritage Area (pNHA) is Cragnashingaun Bogs NHA, which is located approximately 1.8 kilometres to the east of the proposed windfarm.

3.3.2.4 Wind Speeds

The Irish Wind Atlas produced by Sustainable Energy Ireland shows average wind speeds for the country. With the upland nature of the landscape, the Wind Atlas shows that wind speeds on the proposed development site are consistent with a wind farm development as evidenced by the Wind Energy Strategy (WES) designation of the site as a "Strategic Area" and an area "Acceptable in Principle". On-site monitoring of the wind resource, which is ongoing, will further verify that with a sufficient turbine height and blade diameter, the wind resource of the site is commercially viable.

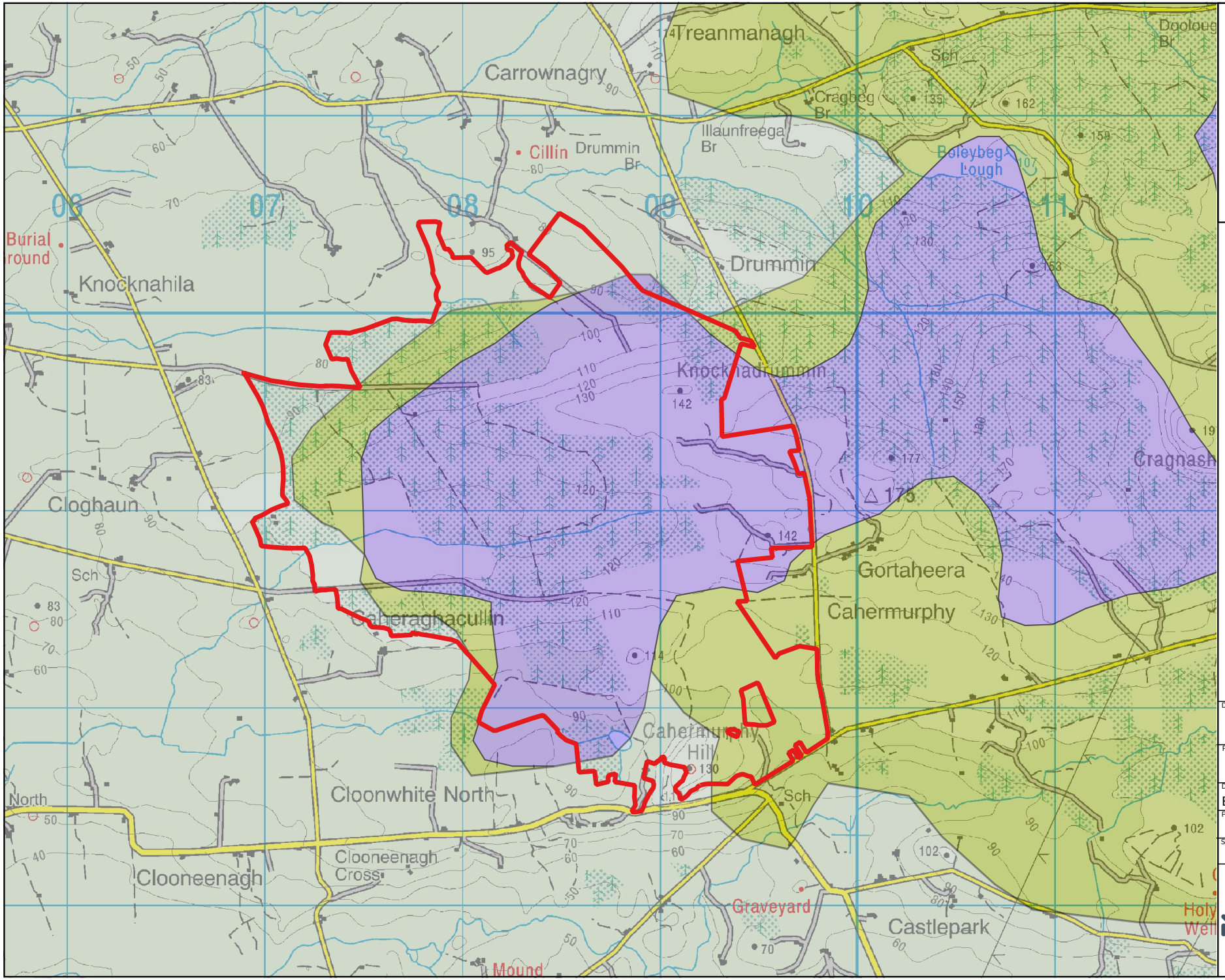
3.3.2.5 Population Density

The applicants sought to identify an area with a relatively low population density. Having reviewed the settlement patterns in the vicinity of the proposed development site, the study area has emerged as suitable to accommodate the proposal. The population density of the Study Area as described in the Population and Human Health section of this EIAR is 12.8 persons per square kilometre, as described in Chapter 5 of this EIAR. This is significantly lower than the average national population density of 68.1 persons per square kilometre.

3.3.2.6 Summary

From the review of the criteria set out above, the currently proposed development site was identified as a suitable location for the provision of a wind farm of the scale proposed. The site of the proposed development is located predominantly within an existing commercial forestry which allows the site to take advantage of existing access roads (which will be upgraded), this when combined with the proximity to the existing Booltiagh and Slievecallan substations further highlights the suitability of the site as it can make further sustainable use of these established items of infrastructure. The proposed site is also designated as a 'Strategic Area' and 'Acceptable In Principle' within the functional area of Clare County Council for the provision of wind farm development, does not overlap with any environmental designations and is also located in an area with a relatively low population density with appropriate annual wind speeds.

The purpose of the site identification exercise was to identify an area that would be capable of accommodating a wind farm development while minimising the potential for adverse impact on the environment. In order to satisfy this requirement, a significant landholding that would yield a sufficient viable area for the siting of each element of the proposed development was required.



Map Legend

- Site Location
- Strategic Areas
- Acceptable in Principle
- Open to Consideration
- Not Normally Permissable

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Drawing Title
County Clare Wind Energy Designations

Project Title
Cahermurphy Two Wind Farm

Drawn By	Checked By
Eoin O'Sullivan	Michael Watson
Project No.	Drawing No.
170238	Figure 3.2
Scale	Date
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3.4 Alternative Renewable Energy Technologies

The proposed wind farm will be located on a site where forestry, agriculture and turbary will continue to be carried out around the footprint of the wind farm. An alternative source of renewable energy considered for the proposed site following its identification was solar energy.

Commercial solar energy production is the harnessing and conversion of sunlight into electricity using photovoltaic arrays (panels). To achieve the same electricity output, as is expected from the proposed wind energy development (c.48MW), from solar energy would require a significantly larger development footprint. In this instance, the proposed wind energy development requires 27.6 hectares of commercial forestry to be permanently felled. A solar PV array of the scale necessary to provide the same electricity output would require the permanent felling of approximately 96 hectares of commercial forestry. In addition, a solar development would have a higher potential environmental effect on Hydrology and Hydrogeology, Traffic and Transport (construction phase) and Biodiversity and Birds (habitat loss, glint and glare) at the site.

For the reasons set out above, the proposal for a wind energy development at this site is considered to be the most efficient method of electricity production with the lesser potential for significant, adverse environmental effects.

A comparison of the potential environmental effects of the development of a solar PV array when compared against the chosen option of developing the proposed wind farm at this site are presented in Table 3-2 below.

Table 3-2 Comparison of environmental effects when compared against the chosen option (wind turbines)

Environmental Consideration	Solar PV Array (with a 48MW output)
Population & Human Health (incl. Shadow Flicker)	No potential for shadow flicker to affect sensitive receptors. Potential for glint and glare impacts on local road users.
Biodiversity & Ornithology	Larger development footprint would result in greater habitat loss. Potential for glint and glare impacts on birds.
Land, Soils & Geology	Larger development footprint would result in greater volumes of peat and spoil to be excavated.
Geotechnical	Shallower excavations involved in solar PV array developments would decrease the potential for peat instability.
Water	A solar PV array development would require a significantly larger area of forestry to be felled therefore increasing the potential for silt laden runoff to enter receiving watercourses.
Air & Climate	Reduced capacity factor of solar PV array technology would result in a longer carbon payback period.
Noise & Vibration	No potential for noise impacts on nearby sensitive receptors.

Environmental Consideration	Solar PV Array (with a 48MW output)
Landscape & Visual	Potentially less visible from surrounding area due to screening from forestry and topography.
Cultural Heritage & Archaeology	Neutral
Material Assets	Potential for greater traffic volumes during construction phase due to the number of solar panels required to achieve the same output.

3.5 Alternative Turbine Numbers and Model

The proposed wind turbines will have a potential power output in the 4 and 5 megawatt (MW) range. It is proposed to install 10 turbines at the site which could achieve approximately 48 MW output. Such a wind farm could also be achieved on the proposed site by using smaller turbines (for example 1.5 MW machines). However, this would necessitate the installation of over 32 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 environmental impacts to occur. 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 10 turbine layout selected for the site has the smallest development footprint, 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 170 metres when measured from ground 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, loudest for noise 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 and would potentially require a larger development footprint. This alternative would potentially lead to additional environmental effects.

A comparison of the potential environmental effects of the installation of a larger number of smaller wind turbines when compared against the chosen option of installing a smaller number of larger wind turbines are presented in Table 3-3 below.

Table 3-3 Comparison of environmental effects when compared against the chosen option (larger, fewer wind turbines)

Environmental Consideration	Larger number of smaller turbine models
Population & Human Health (incl. Shadow Flicker)	Greater potential for shadow flicker impacts on nearby sensitive receptors.

Environmental Consideration	Larger number of smaller turbine models
Biodiversity & Ornithology	Larger development footprint would result in greater habitat loss. Greater potential collision risk for birds due to the presence of more turbines.
Land, Soils & Geology	Larger development footprint would result in greater volumes of peat and spoil to be excavated and stored.
Geotechnical	Neutral
Water	Larger development footprint, therefore, increasing the potential for silt laden runoff to enter receiving watercourses.
Air & Climate	Increased potential for vehicle emissions and dust emissions due to an increased volume of construction material and turbine component deliveries to the site.
Noise & Vibration	Potential for increased noise impacts on nearby sensitive receptors.
Landscape & Visual	A larger number of turbines would have a greater visual impact.
Cultural Heritage & Archaeology	Larger development footprint would increase the potential for impacts on unrecorded, subsurface archaeology.
Material Assets	Potential for greater traffic volumes during construction phase due to larger development footprint and requirement for more construction materials and turbine components.

3.6 Alternative 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. The aim being to reduce potential for environmental effects while designing a project capable of being constructed and viable.

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, 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.

3.6.1 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, 2006) and the *'Best Practice Guidelines for the Irish Wind Energy Industry'* (Irish Wind Energy Association, 2008). 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'* (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 guidance presented in the Department of the Environment, Heritage and Local Government Wind Energy Guidelines (DoEHLG, 2006). As it is considered likely that that the new guidelines will be issued during the application process timeframe, current proposed set back requirements have been incorporated into the design.

The constraints map for the site, as shown in Figure 3.3a and Figure 3.3b, was produced following a desk study of all site constraints.

Figure 3.3a and Figure 3.3b encompasses the following constraints and associated buffers:

- Residential dwellings plus a minimum 700-metre buffer (exceeding the requirement for a 4 x tip height separation distance from the curtilage of properties in line with the new draft guidelines):
- Telecommunication Links plus operator specific buffer;
- Watercourses plus 50-metre buffer;
- Hen Harrier Nest Buffer 1 kilometre; 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:

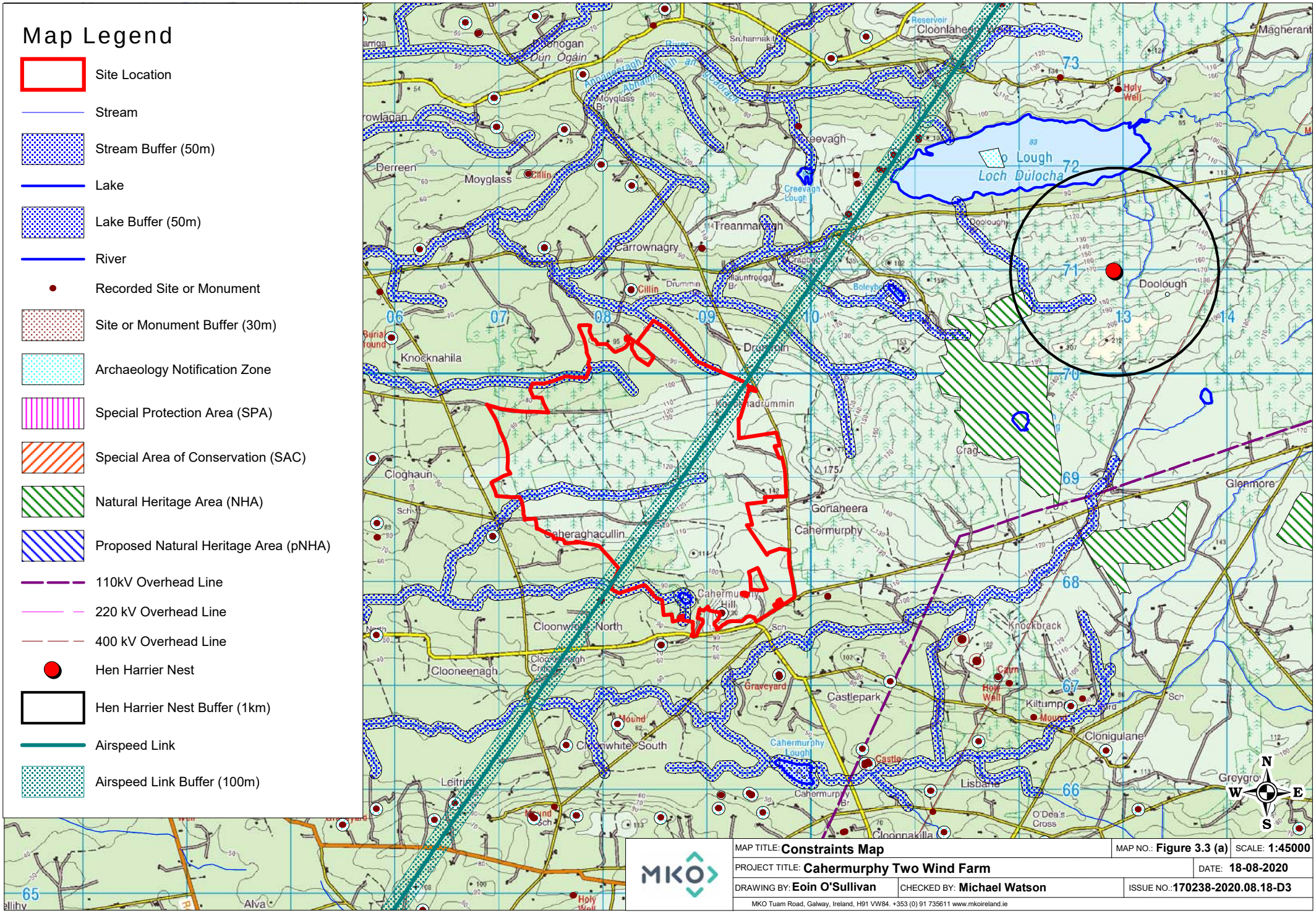
- Available lands for development;
- Separation distance from un-associated landowners;
- Good wind resource;
- Existing access points and general accessibility of all areas of the site due to existing road infrastructure; and
- Limited extent of constraints.

The inclusion of the constraints on a map of the study area allowed for a viable area to be identified. An initial turbine layout was 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 by the project team. The ecological assessment of the site encompassed habitat mapping and extensive surveying of birds and other fauna. This assessment, as described in Chapter 7 of this EIAR on Biodiversity, optimised the decision on the siting of turbines and the carrying out of any development works, such as the construction of roads.

The hydrological and geotechnical investigations of the site examined the proposed locations for turbines, roads and other components of the proposed development, such as the substation and the construction compound. Where specific areas were deemed as being unsuitable for the siting of turbines or roads, etc., alternative locations were proposed and assessed, taking into account the areas that were already ruled out of consideration.

The turbine layout for the proposed wind farm has also been informed by wind data and the results of noise assessments as they became available.



MAP TITLE: **Constraints Map**		MAP NO.: **Figure 3.3 (a)**	SCALE: **1:45000**
PROJECT TITLE: **Cahermurphy Two Wind Farm**			DATE: **18-08-2020**
DRAWING BY: **Eoin O'Sullivan**	CHECKED BY: **Michael Watson**		ISSUE NO.: **170238-2020.08.18-D3**

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MAP TITLE: House Constraints Map	MAP NO.: Figure 3.3 (b)	SCALE: 1:23,000
PROJECT TITLE: Cahermurphy Two Wind Farm		DATE: 13-07-2020
DRAWING BY: Eoin O'Sullivan	CHECKED BY: Michael Watson	ISSUE NO.: 170238-2020.07.13-D2

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3.6.2 Turbine Layout

The final proposed turbine layout takes account of all site constraints and the distances to be maintained between turbines and from houses, roads, etc. The layout is based on the results of all site investigations that have been carried out during the EIAR process. As information regarding the site of the proposed development was compiled and assessed, the number of turbines and the proposed layout have been revised and amended to take account of the physical constraints of the site and the requirement for buffer zones and other areas in which no turbines could be located. 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 EIAR and wind farm design process 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.

The development of the final proposed wind farm layout has resulted following feedback from the various studies and assessments carried out as well as ongoing negotiations and discussions with landowners and the local community.

There were several reviews of the specific locations of the various turbines during the optimisation of the site layout. The initial constraints study identified a significant viable area within the overall study area, suitable for approximately 10 no. turbines. The initial turbine layout, shown in Figure 3.4, occupied the viable area within the wider study area, however the proposed turbine layout was refined following feedback from the project team and applicant. The chosen turbine layout is considered optimal as the alternative, earlier iterations of the layout had the potential for greater environmental effects.

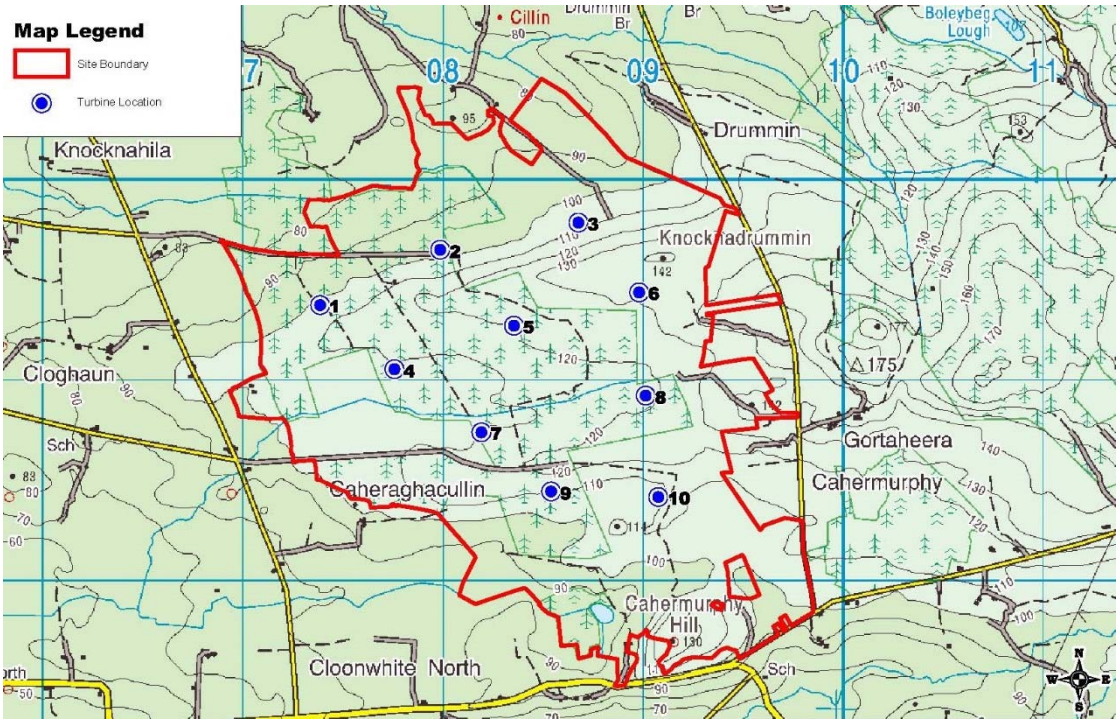


Figure 3.4: Intial Turbine Layout

The first iteration of the turbine layout, shown in Figure 3.5, involved repositioning all turbine locations to achieve greater separation distances between turbines and the permitted Cahermurphy Wind Farm site, residential dwellings and to avoid the Airspeed telecoms link which transverses the site.

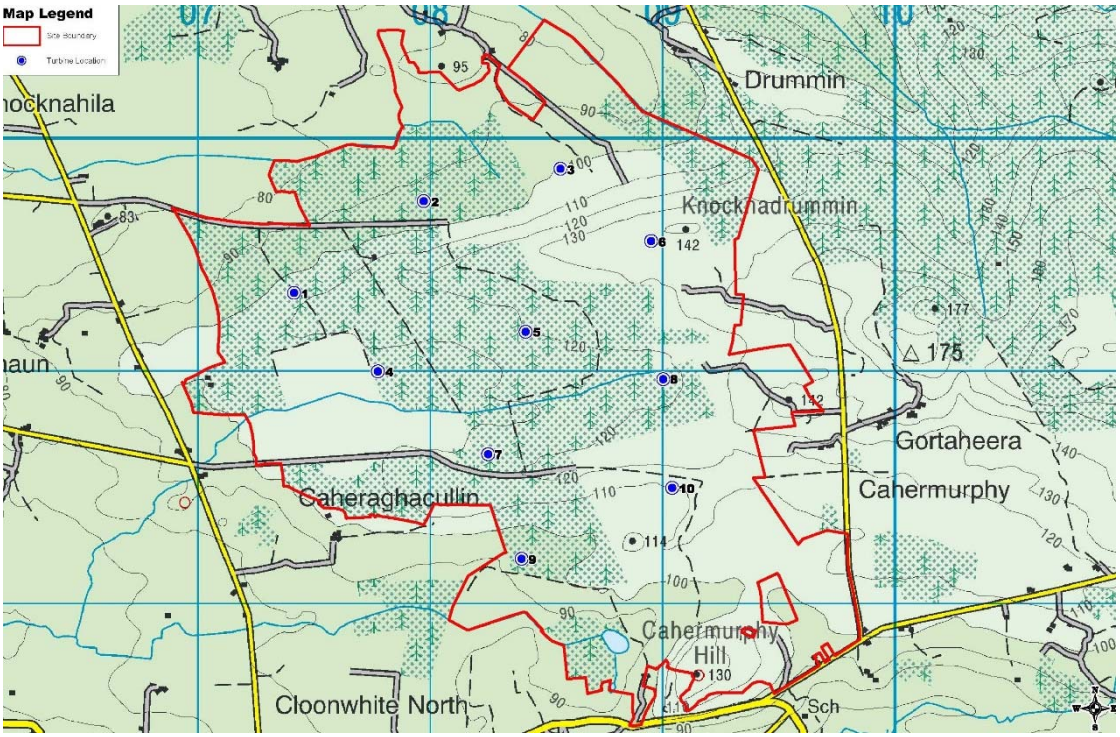


Figure 3.5: First Iteration of the Turbine Layout

The second iteration of the proposed turbine layout, illustrated in Figure 3.6 below, involved moving turbine nos. 4 and 8 in order to avoid peat depths. Turbine no. 5 was also moved 200m north to restore the energy yield loss as a result of moving turbine nos. 4 and 8.

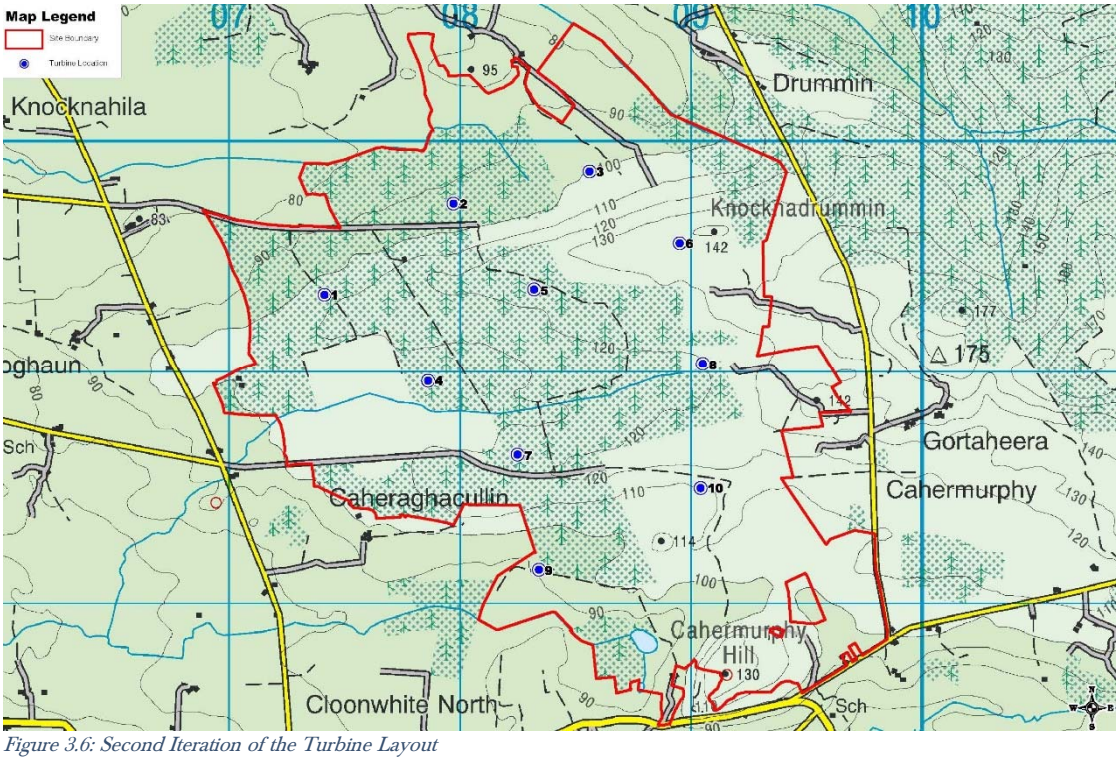


Figure 3.6: Second Iteration of the Turbine Layout

The third and final iteration of the proposed turbine layout, illustrated in Figure 3.7 below, involved moving turbine no. 4, 50m north of its original location and turbine no. 8, 50m south of it current location in order to avoid watercourse buffers.

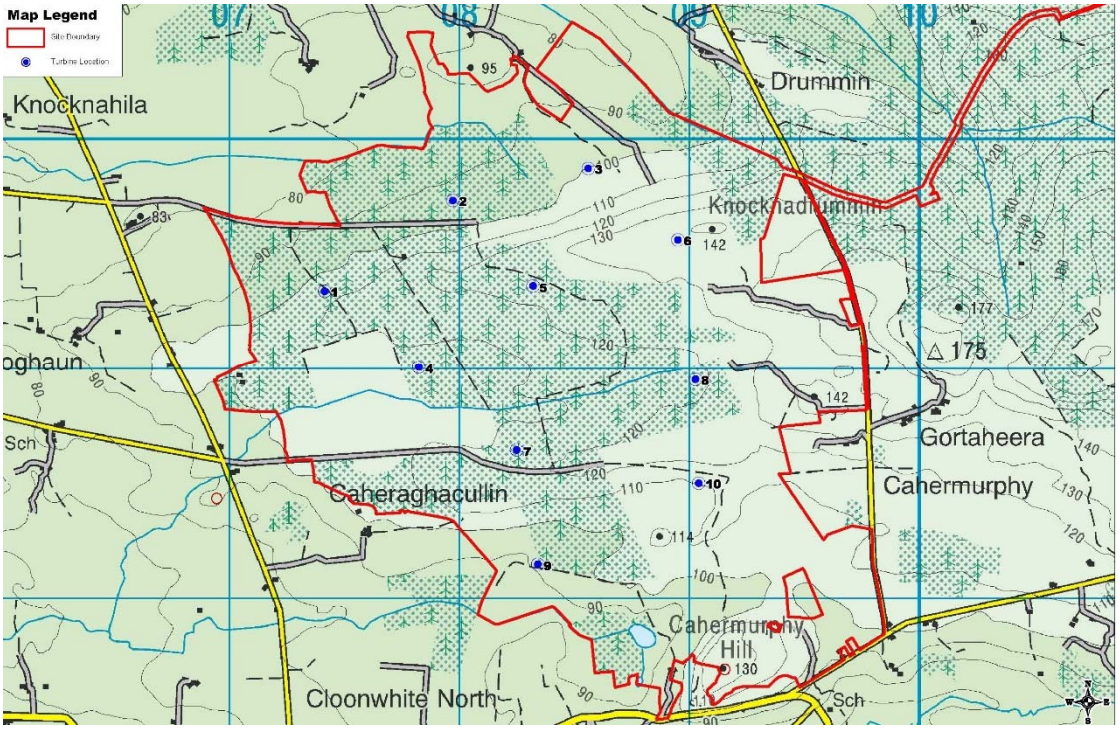


Figure 3.7: Third and Final Iteration of the Turbine Layout

It was also at this point that the site boundary for the purposes of the EIAR was defined. The initial site boundary was amended to focus on the final iteration of the layout and proposed entrance and access route.

The final proposed turbine layout as presented in Figure 3.7 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.

A comparison of the potential environmental effects of the layout as presented in the initial, first and second iterations when compared against the final layout are presented in Table 3-4 below.

Table 3-4 Comparison of environmental effects when compared against the chosen option (final turbine layout)

Environmental Consideration	Initial Layout	First Iteration	Second Iteration
Population & Human Health (incl. Shadow Flicker)	No material environmental difference for population or human health. Potential for increased shadow flicker duration at nearby sensitive receptors.	No material environmental difference for population or human health.	No material environmental difference for population or human health.
Biodiversity & Ornithology	No significant environmental	No significant environmental	No significant environmental

Environmental Consideration	Initial Layout	First Iteration	Second Iteration
	difference for either biodiversity or birds.	difference for either biodiversity or birds.	difference for either biodiversity or birds.
Land, Soils & Geology	This layout was amended following more detailed geotechnical investigations to reduce areas of deep peat and reduce the volume of peat and spoil to be managed.	This layout was amended following more detailed geotechnical investigations to reduce areas of deep peat and reduce the volume of peat and spoil to be managed.	Neutral.
Water	The amendment of this layout resulted in the reduction of the volume of peat and spoil to be managed which in turn reduced potential for water quality effects.	The amendment of this layout resulted in the reduction of the volume of peat and spoil to be managed which in turn reduced potential for water quality effects.	The amendment of this layout avoided the positioning of turbines in watercourse buffers which in turn reduced potential for water quality effects.
Air & Climate	Neutral	Neutral	Neutral
Noise & Vibration	Potential for greater noise impacts due to reduced separation distance between turbines and closest sensitive receptors.	Neutral	Neutral
Landscape & Visual	Neutral	Neutral	Neutral
Cultural Heritage & Archaeology	Neutral	Neutral	Neutral
Material Assets	The amendment of this layout avoided the positioning of turbines in a telecoms buffer.	Neutral	Neutral

3.6.3 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 roadways and tracks where available to minimise the potential for impacts by using new roads as an alternative.

As the overall site layout was finalised, the most suitable routes between each component of the development were identified, taking into account the existing roads and the physical constraints of the site. 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 movement 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 not favoured, as it would require unnecessary disturbance to the site and create the potential for additional environmental impacts to occur. It would also result in an unnecessary requirement for additional cut and fill material to be used in the construction of new roads.

A comparison of the potential environmental effects of constructing an entirely new road network when compared against maximising the use of the existing road network is presented in Table 3-5 below.

Table 3-5 Comparison of environmental effects when compared against the chosen option (maximising the use of the existing road network)

Environmental Consideration	New Road Network
Population & Human Health (incl. Shadow Flicker)	Neutral
Biodiversity & Ornithology	Larger development footprint would result in greater habitat loss.
Land, Soils & Geology	Larger development footprint would result in greater volumes of peat and spoil to be excavated and stored. Larger volume of stone required from on-site borrow pit for road construction.
Geotechnical	Neutral
Water	Larger development footprint and increased number of new watercourse crossings, therefore, increasing the potential for silt laden runoff to enter receiving watercourses.
Air & Climate	Potential for greater dust emissions due to the requirement of an increased volume of stone from the on-site borrow pit. Potential for greater vehicular emissions due to increased volume of construction traffic.
Noise & Vibration	Potential for increased noise impacts on nearby sensitive receptors during the construction of the new roads.
Landscape & Visual	Potential for greater visual and landscape impacts due to the construction of new roads.
Cultural Heritage & Archaeology	Larger development footprint would increase the potential for impacts on unrecorded, subsurface archaeology.
Material Assets	Potential for greater traffic volumes during construction phase due to larger development footprint and requirement for more construction materials.

3.6.4 Location of Ancillary Structures

The ancillary infrastructure required for the proposed development include a temporary construction compound/ electricity substation/ grid connection/borrow pits.

3.6.4.1 Construction Compound

The construction compound will be used for the storage of all construction materials and turbine components. The construction compound is located in the centre of the site and is accessed off new roads that will be constructed and existing roads that will be upgraded within the site. The use of a single temporary construction compound as opposed to two smaller compounds interspersed throughout the site will result in less disturbances to the site and a reduced visual impact arising from the development.

A comparison of the potential environmental effects of constructing a single, large construction compound when compared against constructing two smaller compounds is presented in Table 3-6 below.

Table 3-6 Comparison of environmental effects when compared against the chosen option (Single construction compound)

Environmental Consideration	Two Smaller Construction Compounds
Population & Human Health (incl. Shadow Flicker)	The use of two construction compounds sites has the potential to increase the number of potential dust sources on the site and disturbance to residential receptors in the vicinity of the site.
Biodiversity & Ornithology	Potential for greater disturbance to site ecology using multiple construction compound sites.
Land, Soils & Geology	Neutral
Geotechnical	Neutral
Water	The use of multiple construction compounds sites has the potential to increase the risk of erosion and increase risk to watercourses.
Air & Climate	The use of multiple construction compounds sites has the potential to increase the number of potential dust sources on the site.
Noise & Vibration	Potential for increased noise impacts on nearby sensitive receptors from multiple construction compounds.
Landscape & Visual	Potential for visual impact arising from multiple compounds.
Cultural Heritage & Archaeology	Neutral
Material Assets	Less efficient construction practices due to longer movements of construction vehicles, plant and materials within the site.

3.6.4.2 On-Site Electricity Substation

At the initial stages of the project, one potential location was identified for the proposed on-site substation. However in order to provide flexibility to the electrical network provider, two on-site substation locations options have been assessed and included in the planning application. Only one substation will ultimately be constructed, as described in Section 1.3 of this EIAR.

The locations selected for the on-site substations has had regard to the constraints of the site. Ease of access and minimising distance from turbines were also taken into consideration. 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.

3.6.4.3 Grid Connection

A key consideration in determining the grid connection method for a proposed wind energy development is whether the cabling is undergrounded or run as an overhead line. While overhead lines are less expensive and allow for easier repairs when required, underground lines will have no visual impact. For this reason, it was considered that underground lines would be a preferable alternative to overhead lines. The draft Wind Energy Guidelines 2019 also indicate that underground cables are the preferred option for connection of a wind energy development to the national grid.

The output of the windfarm is such that it needs to connect to a 110kV substation. There are 2 no. existing 110kV electricity substations located within 10km of the proposed development site, namely:

- Booltiagh 110kV Electricity Substation
- Slievecallan 110kV Electricity Substation

Therefore, an underground grid connection cabling route to each of these existing substations was considered and assessed in order to determine which route would be brought forward as part of the planning application. The two routes are shown in Figure 3-8 and are detailed below.

Option A is an underground grid connection cabling route, connecting the proposed onsite electricity substation to the existing Slievecallan 110kV substation. The Slievecallan 110kV substation is located approximately 8 kilometres to the northeast of the site. The grid connection cabling route runs entirely along a combination of forestry, agricultural and public roads. The cabling route measures approximately 12.1 km in length.

Option B is an underground cabling route connecting the proposed onsite substation to the existing Booltiagh 110kV substation. The Booltiagh substation is located 7 kilometres to the southeast of the site. This grid connection cabling route runs entirely along a combination of forestry, agricultural and public roads. The cabling route measures approximately 12.1 km in length.

As can be observed from Figure 3-8 both Option A and B share the same route before diverging southeast of Doo Lough. The shared route covers a distance of approximately 6.1km.

The hydrological, environmental and ecological investigations undertaken at the site examined the proposed grid connection options A (Slievecallan route) and B (Booltiagh route). A summary of the findings from the investigations are discussed below:

Hydrology and Hydrogeological Investigation

- The majority of grid connection route Option A and Option B are located in the Annageeragh River catchment (1.5km of grid Option B near the Booltiagh WF Substation extends into the Doonbeg River catchment while 1km of grid Option A extends into the Annagh River catchment at the Slievecallan WF substation end of the route).
- Within the Annageeragh River catchment, approximately 8km of the grid Option A and 5.3km of grid Option B drain into Doo Lough.
- With respect to the grid connection options surface water quality impacts on the downstream Doo Lough are not anticipated and therefore impacts on the Doo Lough surface water abstraction are also not anticipated.
- No groundwater level impacts are anticipated from the construction of the grid connection underground cabling trench due to the shallow nature of the excavation.
- With respect to the proposed grid connection options, no impacts on groundwater wells are anticipated due to the shallow nature of the proposed cable trench.
- With respect the grid connection watercourse crossings, 3 construction crossing methods are proposed that will avoid in-stream works.

In conclusion, both cable route Option A and Option B are viable from a hydrological and hydrogeological perspective.

Ecological

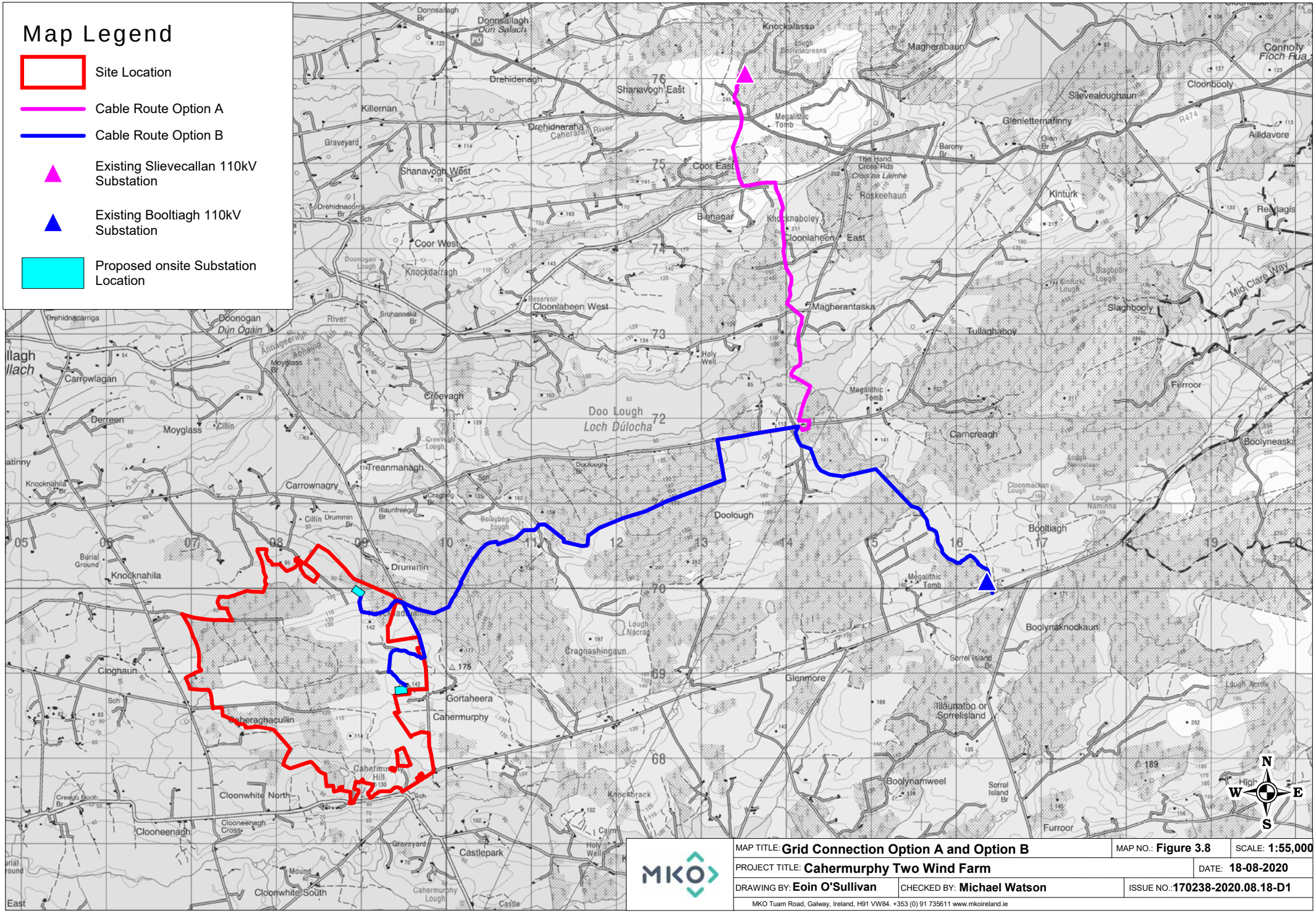
- Small areas of wet heath will be lost along the proposed Slievecallan and Booltiagh cable routes.
- The proposed cable route options will also result in the loss of lowland blanket bog/wet heath habitat mosaic to facilitate the laying of the proposed cable route and the construction of its associated access track.
- Potential indirect effects on the habitats include drainage associated with the construction phase of the development. The effect will be restricted to the locations where these habitats will be lost. The effect will be localised and is not likely to have any effect on peatlands that are not immediately adjacent to the proposed infrastructure.
- The effect is characterised as slight because the development has been specifically designed to avoid peatland habitats where possible and impact on areas that are heavily altered through drainage, turf cutting and grazing.

In conclusion, while both cable route Option A and Option B will result in the loss of some habitat, the effect is considered to be slight. Notwithstanding, a habitat management plan would be prepared to mitigate for loss of habitats along both grid connection routes.

Environmental

A total of 11 no. watercourse crossings were identified along the proposed underground grid connection route option A. A total of 9 no. watercourse crossings were identified along the proposed underground grid connection route option B. Watercourse crossings methods are proposed that will avoid in-stream works along the route.

In conclusion, both cable route Option A and Option B are viable from an environmental perspective.



MAP TITLE: **Grid Connection Option A and Option B** | MAP NO.: **Figure 3.8** | SCALE: **1:55,000**

PROJECT TITLE: **Cahermurphy Two Wind Farm** | DATE: **18-08-2020**

DRAWING BY: **Eoin O'Sullivan** | CHECKED BY: **Michael Watson** | ISSUE NO.: **170238-2020.08.18-D1**

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Reason for Choosing the Proposed Grid Connection - Land Availability

Landowner consents for a section of the Slievecallan grid connection route were not available at the time of report writing and therefore grid connection Option B was the most favoured option of those considered.

A comparison of the potential environmental effects of the grid connection Option A when compared against the chosen option (option B) is presented in Table 3-7 below.

Table 3-7 Comparison of environmental effects when compared against the chosen option (Option B)

Environmental Consideration	Option A
Population & Human Health (incl. Shadow Flicker)	Neutral
Biodiversity & Ornithology	Slight increase in habitat loss for Option A when compared to Option B.
Land, Soils & Geology	Neutral
Geotechnical	Neutral
Water	Option A has slightly more watercourse crossings which would increase the potential for silt-laden runoff and hydrocarbons to enter receiving watercourses.
Air & Climate	Neutral
Noise & Vibration	Neutral
Landscape & Visual	Neutral
Cultural Heritage & Archaeology	Neutral
Material Assets	Neutral

3.6.4.4 Borrow Pits

Material required for the construction of access roads and turbine bases will be obtained from two borrow pits onsite and will be located to the west of Turbine No. 6 and the northeast of Turbine No. 10. The use of borrow pits represent an efficient use of existing onsite resources and eliminates the need to transport large volumes of construction materials along the local public road network to the site. The location for the borrow pits were identified taking into account the site characteristics, including topography, ground conditions, habitat type and surface water features.

An alternative to using onsite borrow pits was the option of sourcing stone and hardcore materials from a licensed quarry in the vicinity. The movement of such material would result in a significant increase in construction traffic and heavy loads and was therefore considered the least preferable option.

A comparison of the potential environmental effects of using onsite borrow pits in comparison to using an offsite quarry is presented in Table 3-8 below.

Table 3-8 Comparison of environmental effects when compared against the chosen option (onsite borrow pit)

Environmental Consideration	Off-site Quarry
Population & Human Health (incl. Shadow Flicker)	Potential for increased vehicular and dust emissions from transporting material from offsite quarry locations to the site which could have adverse health effects.
Biodiversity & Ornithology	Neutral
Land, Soils & Geology	Neutral
Geotechnical	Neutral
Water	Neutral
Air & Climate	Potential increase in dust emissions and vehicle emissions associated with off-site vehicle movements.
Noise & Vibration	Whilst there would be less noise generated from site as a result of using an offsite source, there is still the potential for an increase in noise emissions from the transport of material from offsite quarry locations.
Landscape & Visual	Neutral

3.7 Alternative Transport Route and Site Access

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.

3.7.1 Port of Entry

The alternatives considered for the port of entry of wind turbines into Ireland for the proposed development include Dublin Port and the Port of Galway. Dublin Port is the county's principal seaport catering for approximately two-thirds of Ireland's port traffic. 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 Shannon-Foynes), offer potential for the importing of turbine components and therefore are equally viable alternatives.

3.7.2 Delivery to Site

In assessing the most suitable route for turbine transport, cognisance was taken of the haul route used for the recently constructed Cahermurphy Wind Farm, which is located directly to the east of the proposed development site.

This route utilised the N68 National Secondary Road from Ennis to its junction with the R484 Regional Road, which provides access to Kilmihil village. From Kilmihil, the turbine delivery route continues on the R484 towards Creegh. At Creegh, the turbine delivery route turns right at the crossroad onto a

local road passing Creegh North, Clooneenagh and Cahermurphy Hill after which it takes a left onto a local road approaching Cahermurphy Wind Farm from the south.

This route has proven suitable for the transport of turbine components, and the updated transport analysis (as presented in Section 13.1 of this EIAR), shows that only minor accommodation works will be required to accommodate the proposed Cahermurphy Two Wind Farm turbines. The turbine transport route will utilise the national and primary roads available which ensures the road network holds the capacity to manage large loads.

The delivery route for general HGV construction traffic will follow a more direct route to the site via the local road network from the village of Kilmihil as shown on Figure 4.20 in Chapter 4 of this EIAR. It is noted that this route was used for general construction traffic for the Cahermurphy Phase 1 Wind Farm development.

3.8 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. Any forestry felled within the footprint of the site will be replaced offsite, with no net loss. 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 Clare County Council.

The Proposed Development comprises:

a. *Construction of up to 10 No. wind turbines with a maximum overall blade tip height of up to 170 metres and associated hard stand areas;*
b. *1 no. permanent Meteorological Mast with a maximum height of up to 100 metres;*
c. *1no. 38kV permanent electrical substation which will be constructed at one of two possible locations on site: either Option A in Carrownagry South townland or Option B in Cahermurphy townland. The electrical substation will have 1 no. control building with welfare facilities, all associated electrical plant and equipment, security fencing, all associated underground cabling, waste water holding tank and all ancillary works;*
d. *All associated underground electrical and communications cabling connecting the turbines to the proposed on-site substation;*
e. *All works associated with the connection of the proposed wind farm to the national electricity grid via an underground cable to the existing Booltiagh 110kV substation;;*
f. *Upgrade of existing tracks, roads and provision of new site access roads and hardstand areas;*
g. *Junction access road works;*
h. *2 no. borrow pits;*
i. *1 no. temporary construction compound;*
j. *Site Drainage;*
k. *Forestry Felling to facilitate construction and operation of the proposed development; and*
l. *All associated and ancillary site development works.*

This application seeks a ten year planning permission and 30 year operational life from the date of commissioning of the entire wind farm.

All elements of the proposed project as described in this chapter, including the proposed development as described above and replanting and any works required on public roads to accommodate turbine delivery, have been assessed as part of this EIAR.

The planning application for the proposed wind farm includes connection to the national electricity grid. The planning application includes 2 No. substations; however, only one substation and associated grid connection will ultimately be constructed.

The proposed wind farm will connect to the national grid via one of the following methods:

- Option A: It is proposed to construct a 38 kV substation at the northern end of the site and to connect from here to the existing Booltiagh 110kV substation, located approximately 7 kilometres to the southeast of the site. Option A also includes for an alternative cable route running from the proposed onsite substation south to the access road and north along the local road to the east of the site. The alternative cable route option measures approximately 1.7 km in length. Connection via the Booltiagh route would comprise underground cabling, measuring approximately 12.1

km in total, located on existing forestry and agricultural land and within the public road corridor.

Or

- Option B: It is proposed to construct a 38kV substation at the south eastern end of the site and to connect from here to the existing Booltiagh 110kV substation, located approximately 7 kilometres to the southeast of the site. Connection via the Booltiagh route would comprise underground cabling, measuring approximately 12.1 km in total, located on existing forestry and agricultural land and within the public road corridor.

The substation options are required to provide flexibility to the electrical network provider when determining the most appropriate connection point for the export of the electricity to the national grid. The proposed on-site electrical substation will have one control building, associated electrical plant and equipment, and waste water holding tank and will be constructed in accordance with ESB substation specifications and requirements.

Both substations options and the associated grid connection to Booltiagh have been reviewed as part of this EIAR. It is considered that any works required to Booltiagh substation as part of the grid connection would be minor in nature and would not be likely to have any significant environmental effects.

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 3.6.1 of this EIAR, has been carried out to ensure that turbines and ancillary infrastructure are located in the most appropriate areas of the site. The Proposed Development layout makes maximum use of the existing access road and tracks within 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, borrow pits, construction compound, internal roads layout and the main site entrance. Detailed site layout drawings of the Proposed Development are included in Appendix 4.1 to this EIAR.

Map Legend

- EIAR Study Boundary
- Proposed Turbine Location
- Proposed Met Mast Location
- Proposed 38kV Substation Location - Option A
- Proposed 38kV Substation Location - Option B
- Proposed Construction Compound
- Proposed Borrow Pit Location
- Existing Roads - Upgrade Proposed
- Proposed New Site Roads
- Proposed Grid Connection
- Alternative Grid Connection Option
- Existing Booltiagh 110kV Substation

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MAP TITLE: **Proposed Development Layout Map**	MAP NO.: **Figure 4.1**	SCALE: **1:25,000**
PROJECT TITLE: **Cahermurphy Two Wind Farm**		DATE: **20-08-2020**
DRAWING BY: **Eoin O'Sullivan**	CHECKED BY: **Michael Watson**	ISSUE NO.: **170238-2020.08.20-D4**

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4.3 Development Components

4.3.1 Wind Turbines

4.3.1.1 Turbine Locations

The proposed wind turbine layout has been optimised using industry standard wind farm design software 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.

Table 4-1 Proposed Wind Turbine Locations and Elevations

Turbine No.	Irish Transverse Mercator Co-ordinates		Elevation (m OD)
	Easting (m)	Northing (m)	
1	507384	669377	105
2	507942	669771	91
3	508531	669910	97
4	507794	669044	104
5	508291	669400	124
6	508921	669600	134
7	508219	668683	112
8	508998	668990	118
9	508312	668186	90
10	509012	668538	110

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)
- Rotor

Plate 4-1 Wind turbine components

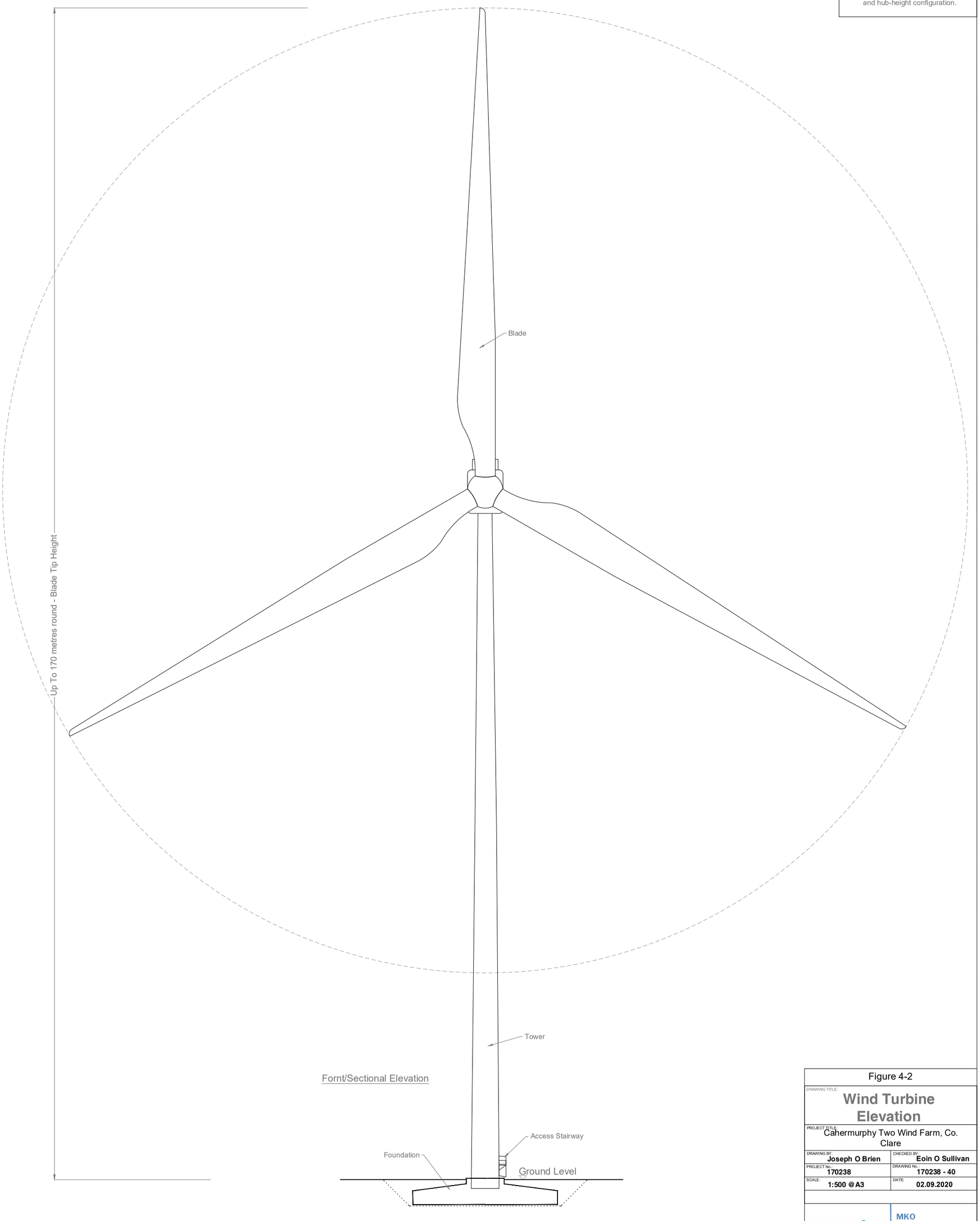
The proposed wind turbines will have a tip height of up to 170 metres. Within this size envelope, various configurations of hub height, rotor diameter and ground to blade tip height may be used. The exact make and model of the turbine will be dictated by a competitive tender process, but it will not exceed a tip height of up to 170 metres. 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.

For the purposes of this EIAR, various types and sizes of wind turbines within the 170-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 ecology (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 and represent the worst case scenario for the relevant section.

A drawing of the proposed wind turbine is shown in Figure 4-2. The individual components of a typical geared wind turbine nacelle and hub are shown in Figure 4-3 below.

Drawing Notes

1. Proposed wind turbines to have a maximum ground to blade tip height of up to 170m.
2. Exact make and model of the turbine to be dictated by a competitive tender process.
3. Installed wind turbine not to exceed maximum size envelope set out above in any blade length and hub-height configuration.



Fornt/Sectional Elevation

Figure 4-2

DRAWING TITLE:
Wind Turbine Elevation

PROJECT TITLE:
Cahermurphy Two Wind Farm, Co. Clare

DRAWING BY:	CHECKED BY:
Joseph O Brien	Eoin O Sullivan
PROJECT No.: 170238	DRAWING No.: 170238 - 40
SCALE: 1:500 @A3	DATE: 02.09.2020

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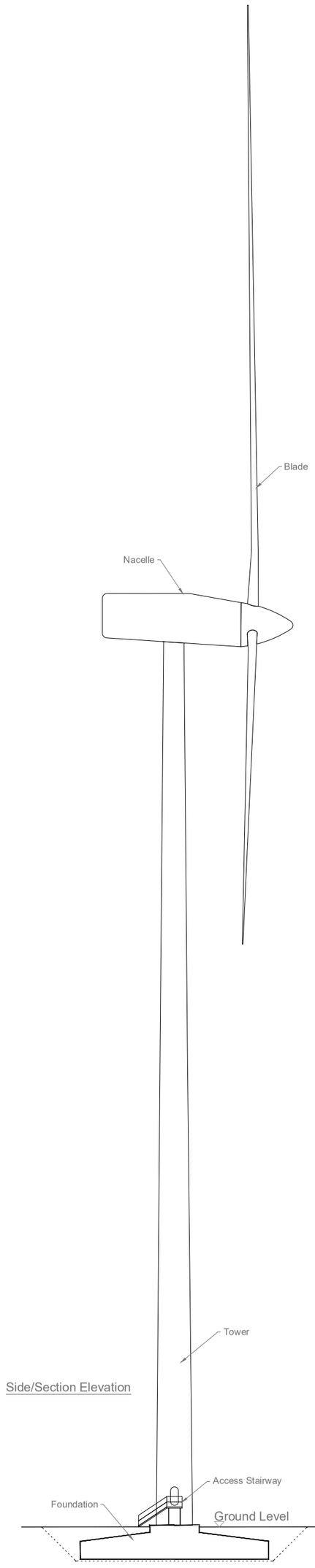
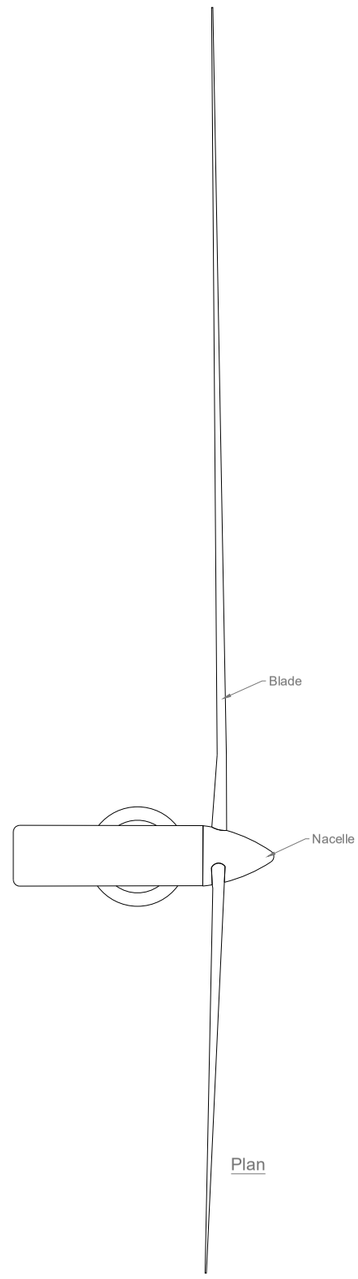
Drawing Notes

1. Proposed wind turbines to have a maximum ground to blade tip height of up to 170m.
2. Exact make and model of the turbine to be dictated by a competitive tender process.
3. Installed wind turbine not to exceed maximum size envelope set out above in any blade length and hub-height configuration.



Side/Section Elevation



Plan

Figure 4-2

DRAWING TITLE:
Wind Turbine Elevation & Plan

PROJECT TITLE:
Cahermurphy Two Wind Farm, Co. Clare

DRAWING BY:	CHECKED BY:
Joseph O Brien	Eoin O Sullivan
PROJECT No.: 170238	DRAWING No.: 170238 - 41
SCALE: 1:500 @A3	DATE: 02.09.2020

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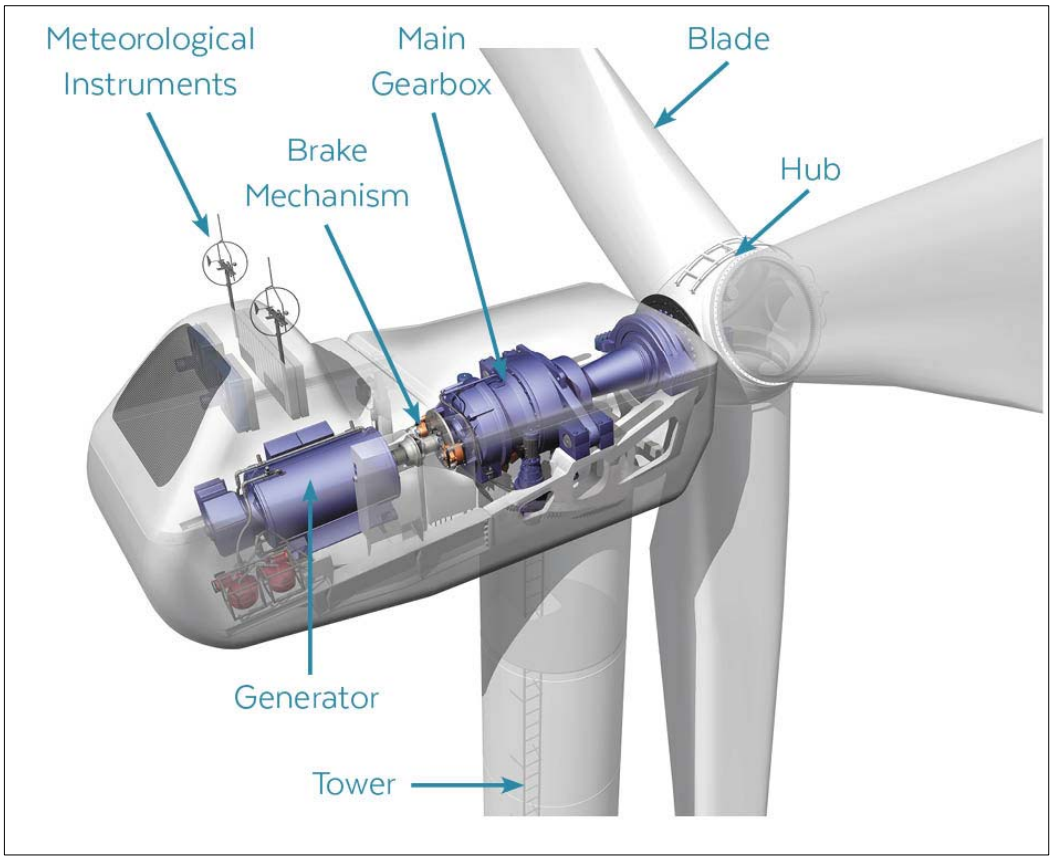


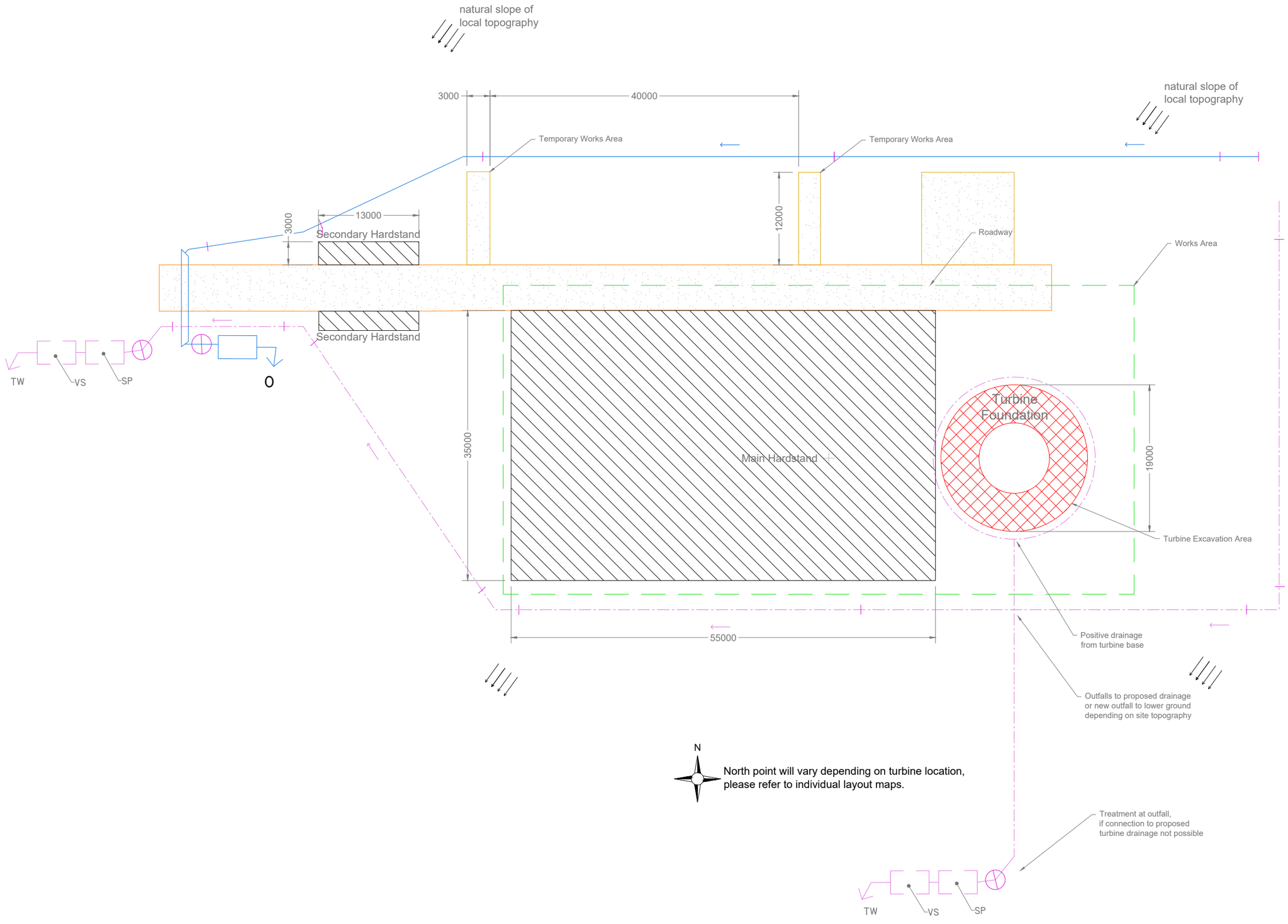
Figure 4-3 Turbine nacelle and hub components

Figure 4-4 shows a typical turbine base layout, including turbine foundation, hard standing area, assembly area, access road and surrounding works area.

4.3.1.3 Turbine Foundations

Each wind turbine is secured to a reinforced concrete foundation that is installed below the finished ground level. The size of the foundation will be dictated 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 and a foundation area large enough to accommodate all modern turbine models has been assessed in this EIAR. 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 4-4.

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. 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 4-2 below).



Drawing Legend

- Upstream Interceptor Drain
- Swales/Downstream Collector Drain
- Direction of flow
- Settlement Pond - Vegetation Filter - Level Spreader
- Check Dam 'Type A'
- Check Dam 'Type B'
- Interceptor Ditch Culvert
- Collector Ditch Culvert
- O — Overland Flow Discharge
- TW — Treated Water Discharge
- SP — Settlement Pond
- VS — Semi-Natural Vegetation Swale / Filter Bed /secondary SP

Proposed Drainage

Figure 4-4

DRAWING TITLE:
Turbine Hardstand Layout Standard Detail

PROJECT TITLE:
Cahermurphy Two Wind Farm, Co. Clare

DRAWING BY:	CHECKED BY:
Joseph O Brien	Eoin O Sullivan
PROJECT No.: 170238	DRAWING No.: 170238 - 39
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Plate 4-2 Turbine 'Anchor Cage' and 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 report are the sizes required, but the extent of the required areas at each turbine location may be optimised within these parameters 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 4-4. 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 within the parameters shown on the planning application drawings and assessed in this EIAR.

4.3.1.6 Power Output

It is anticipated the proposed wind turbines will have a rated electrical power output in the range of 3.5 to 4.8 megawatt (MW) 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 4.8MW has been chosen to calculate the power output of the proposed 10-turbine wind farm, which would result in an estimated installed capacity of 48MW.

Assuming an installed capacity of 48 MW, the Proposed Development therefore has the potential to produce up to 147,168 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 35% is applied here

C = ... Rated output of the wind farm: 48 MW

The 147,168 MWh of electricity produced by the Proposed Development would be sufficient to supply 35,040 Irish households with electricity per year, based on the average Irish household using 4.2 MWh[1] of electricity.

The 2016 Census of Ireland recorded a total of 43,469 occupied households in Co. Clare. Per annum, based on a capacity factor of 35%, the Proposed Development would therefore produce sufficient electricity for the equivalent of approximately 81% of all households in Co. Clare.

4.3.2 Site Roads

4.3.2.1 Road Construction Types

To provide access within the site of the Proposed Development and to connect the wind turbines and associated infrastructure existing tracks will need to be upgraded and new access roads will need to be constructed. The road construction preliminary design has taken into account the following key factors as stated in the Fehily Timoney & Company's (FTC) *Peat and Spoil Management Plan* in Appendix 4-2 of this EIAR:

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.

4.3.2.1.1 *Upgrade to Existing Roads or Tracks*

The general construction methodology for upgrading of existing sections of excavated and floating roads or tracks, as presented in AGEC's *Peat & Spoil Management Plan* in Appendix 4-2 of this EIAR, is summarised below. This methodology includes procedures that are to be included in the construction to minimise any adverse impact on peat stability.

1. *For upgrading of existing excavated access tracks the following guidelines apply:*
    a. *Excavation will be required on one or both sides of the existing access track to a competent stratum.*
    b. *Granular fill to be placed in layers in accordance with the designer's specification.*
    c. *The surface of the existing access track should be overlaid with up to 300mm of selected granular fill.*
    d. *Access roads to be finished with a layer of capping across the full width of the road.*
    e. *A layer of geogrid/geotextile may be required at the surface of the existing access road (to be confirmed by the designer).*
    f. *For excavations in peat & spoil, side slopes shall be not greater than 1 (v): 2 or 3 (h). This slope inclination should be reviewed during construction, as*

1 March 2017 CER (CRU) Review of Typical Consumption Figures Decision https://www.cru.ie/document_group/review-of-typical-consumption-figures-decision-paper/

appropriate. Where areas of weaker peat are encountered then slacker slopes will be required.

2. *For upgrading of existing floated access tracks the following guidelines apply:*
    a. *The typical make-up of the existing floating access roads on site appears to be locally tree brash/trunks laid directly onto the peat surface and/or geotextile overlain by up to 400mm of coarse granular fill/till type (fine granular/cohesive) site won material. It should be noted that there are localised variations in the make-up of the existing floated access tracks on site, frequently no tree brash/trunks were used in the make-up and the presence of a geogrid was also noted in localised sections of the existing track.*
    b. *The surface of the existing access track will be graded/tidied up prior the placement of any geogrid/geotextile, where necessary (to prevent damaging the geogrid/geotextile).*
    c. *Where coarse granular fill has been used in the existing floated access road make-up, a layer of geogrid will be placed on top of the existing floated access track.*
    d. *Where fine granular/cohesive type material has been used in the existing floated access road make-up (as is the case on some of the existing access roads in the southeast of the site), a layer of geotextile is likely to be required as a separator layer with a layer of geogrid.*
    e. *The geogrid may be overlaid with up to 900mm of selected granular fill. Granular fill to be placed in layers in accordance with the designer's specification.*
    f. *Additional geogrid and granular fill may be required in certain sections of the works (to be confirmed by the designer).*

3. *The straight section of finished road width will be approximately 5m.*

4. *On side long sloping ground any road widening works required will 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 10 to 20m 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.*

A typical section of existing excavated road for upgrade is shown in Figure 4-5. A typical section through an existing floating road to be upgraded is shown in Figure 4-6.

4.3.2.1.2 Construction of New Excavated Roads

Excavate and replace type access roads are the conventional method for construction of access roads on peatland sites and the preferred construction technique in shallow peat provided sufficient placement/reinstatement capacity is available on site for the excavated peat.

The general construction methodology for the construction of excavated roads, as presented in FTC's *Peat & Spoil Management Plan* in Appendix 4-2 of this EIAR, 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 road construction movement monitoring posts will be installed in areas where the peat depth is greater than 2m.*

2. *Interceptor drains will be installed upslope of the access road alignment to divert any surface water away from the construction area.*

3. *Excavation will take place to a competent stratum beneath the peat. Peat depths recorded across the site ranged from 0 to 4.5m with an average of 0.8m.*

4. *Road construction will be carried out in sections of approximately 50m lengths i.e. no more than 50m of access road will be excavated without re-placement with stone fill.*

5. *Excavation of materials with respect to control of peat stability.*

    a. Acrotelm (top about 0.3 to 0.4m of peat) is generally required for landscaping and shall be stripped and temporarily stockpiled for re-use as required. Acrotelm stripping shall be undertaken prior to main excavations.
    b. Where possible, the acrotelm shall be placed with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation.
    c. All catotelm peat (peat below about 0.3 to 0.4m depth) shall be transported immediately on excavation to the designated areas.

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 will be carried out as the excavation progresses.*

7. *The surface of the excavated access road will be overlaid with up to 500mm of selected granular fill. Granular fill to be placed in layers in accordance with the designer's specification.*

8. *Access roads to be finished with a layer of capping across the full width of the road.*

9. *A layer of geogrid/geotextile may be required at the surface of the competent stratum (to be confirmed by the designer).*

10. *At transitions between floating and excavated roads a length of road of about 10 to 20m 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.*

11. *Where relatively steep peat slopes are encountered along with relatively deep peat (i.e. typically greater than 1m) 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.*

12. *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.*

A typical section of a new excavated road is shown in Figure 4-7.

4.3.2.1.3 Construction of New Floating Roads

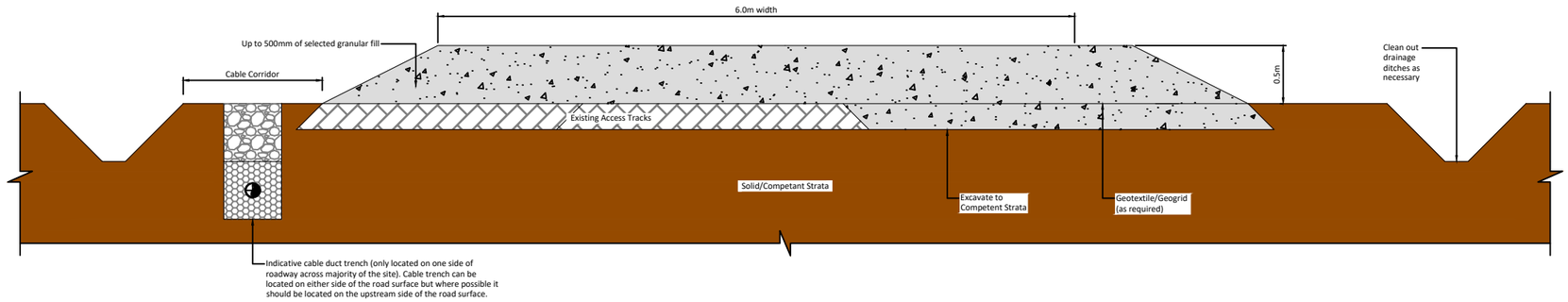
Due to the relatively shallow nature of the site and the relatively steep slope angles, floating roads have not been considered for the site. However, the methodology for the construction of floating roads has been included for information purposes.

A detailed stability analysis to confirm the conditions predicted in this EIAR will be carried out by the designer where it is proposed to install floating access roads over the peat prior to any construction work commencing on site.

Floating roads minimise impact on the peat, particularly peat hydrology. As there is no excavation required no peat arisings are generated. However, where the underlying peat has insufficient bearing capacity or due to topographic restrictions an excavated type access road may be more suitable.

The general construction methodology for the construction of floating roads, as presented in AGEC's Peat and Spoil Management Plan in Appendix 4-2 of this EIAR, 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 will be installed in areas where the peat depth is greater than 3m.*
2. *Base geogrid to be laid directly onto the existing peat surface along the line of the road in accordance with geogrid provider's requirements.*
3. *Construction of road to be in accordance with appropriate design from the designer.*
4. *The typical make-up of the new floated access road is 1000 to 1200mm of selected granular fill with 2 no. layers of geogrid with possibly the inclusion of a basal layer of tree trunks/brash (To be confirmed with the site designer).*
5. *Granular fill to be placed in layers in accordance with the designer's specification.*
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 2 to 5m wide pressure berm (typically 0.5m in height) either side of the access road will reduce the likelihood of potential bearing failures beneath the access road.*
7. *The straight section of finished running width of the road will be approximately 5m.*
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, suitable machinery shall be employed to spread and place the tipped stone over the base geogrid along the line of the road.*



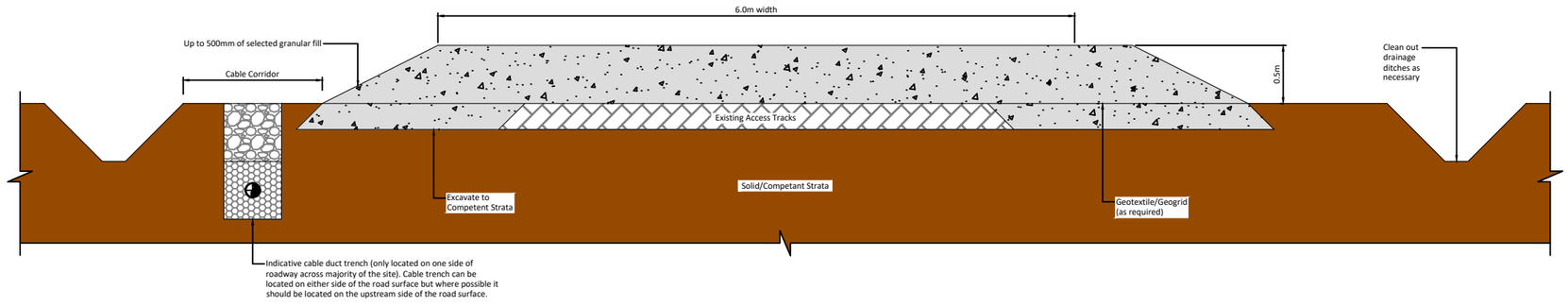


Figure 4-5

DRAWING TITLE:
Type A Upgrade of Existing Excavated Access Tracks

PROJECT TITLE:
Cahermurphy Two Wind Farm, Co. Clare

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PROJECT No.: 170238	DRAWING No.: 170238 - 42
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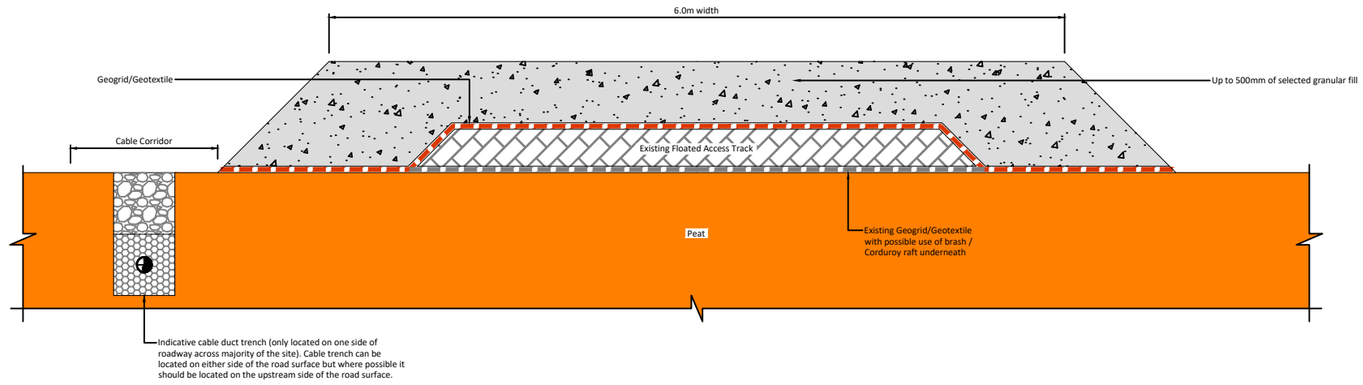

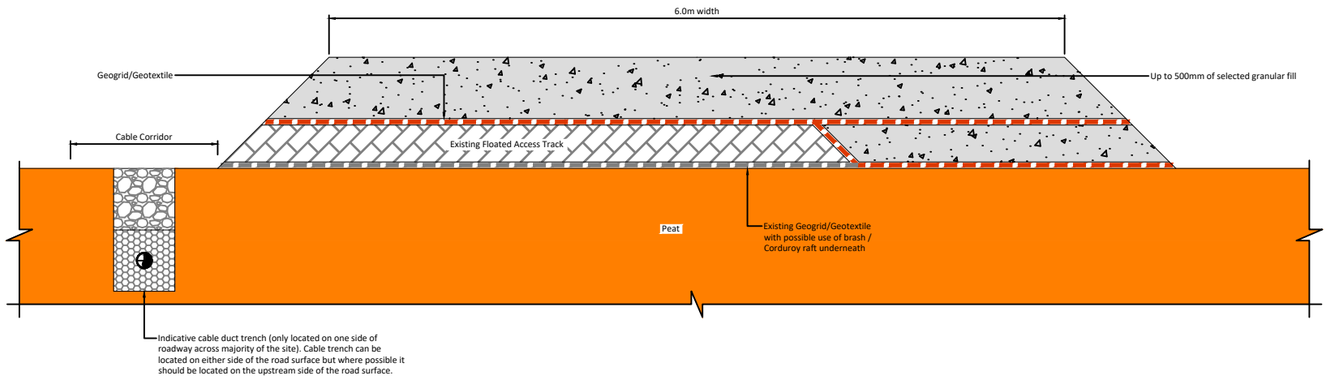

Figure 4-6

DRAWING TITLE:
Type B Upgrade of Existing Floated Access Tracks

PROJECT TITLE:
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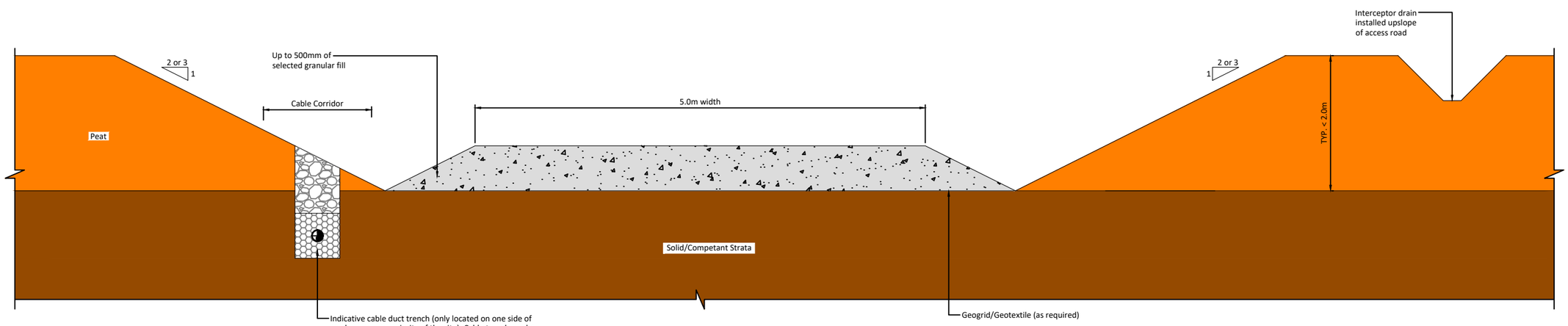

Figure 4-7

DRAWING TITLE:
Type C New Excavate and Replace Access Road

PROJECT TITLE:
Cahermurphy Two Wind Farm, Co. Clare

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PROJECT No.: 170238	DRAWING No.: 170238 - 44
SCALE: 1:50 @ A3	DATE: 01.09.2020

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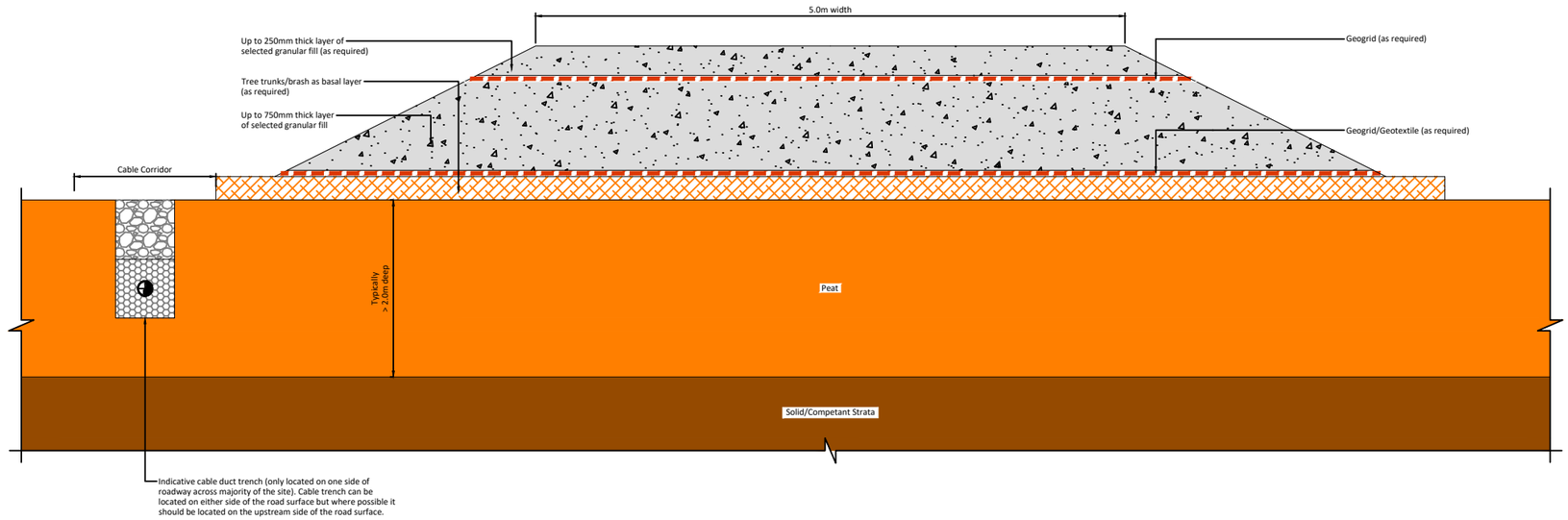

Figure 4-8

DRAWING TITLE:
Type D New Floated Access Road

PROJECT TITLE:
Cahermurphy Two Wind Farm, Co. Clare

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PROJECT No.: 170238	DRAWING No.: 170238 - 45
SCALE: 1:50 @ A3	DATE: 01.09.2020

OS SHEET No.: 4315, 4316, 4317, 4318, 4373, 4374, 4375, 4376, 4431, 4432, 4333, 4334, 4490, 4491, 4492, 4493

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12. *A final surface capping layer shall be placed over the full width of the floating road, as per design requirements, to provide a road profile and graded to accommodate wind turbine construction and delivery traffic.*

A typical section of a new floating road is shown in Figure 4-8.

4.3.3 Borrow Pits

4.3.3.1 Description

It is proposed to develop 2 No. on-site borrow pits as part of the Proposed Development. It is proposed to obtain the majority of all rock and hardcore material that will be required during the construction of the proposed development from the on-site borrow pits. Usable rock may also be won from other infrastructure construction including the substation and the turbine base excavations.

Borrow pit No. 1 located approximately 120 metres to the west of Turbine No. 6, measures approximately 12,300m^2 in area and is intended to supply hardcore materials for the construction of the turbines in the north of the site, access roads thereto, the electricity substation and the temporary construction compound. Borrow pit No. 2 located approximately 150 metres to the northeast of Turbine No. 10, measures approximately 13,600m^2 in area and is intended to supply hardcore materials for the construction of turbines in the south of the site, access roads thereto, the electricity substation and the anemometry mast.

All borrow pits are shown on Figure 4-1 and on the detailed site layout drawings included as Appendix 4-1 to this EIAR. Figure 4-9 and Figure 4-10 below shows detailed sections through the proposed borrow pits. The borrow pits will, on removal of all necessary and useful rock, be reinstated with excavated peat and subsoils as described in Section 4.3.4 below.

Post-construction, the borrow pits areas will be permanently secured and a stock-proof fence will be erected around the borrow pit areas to prevent access to these areas. Appropriate health and safety signage will also be erected on this fencing and at locations around the fenced area.

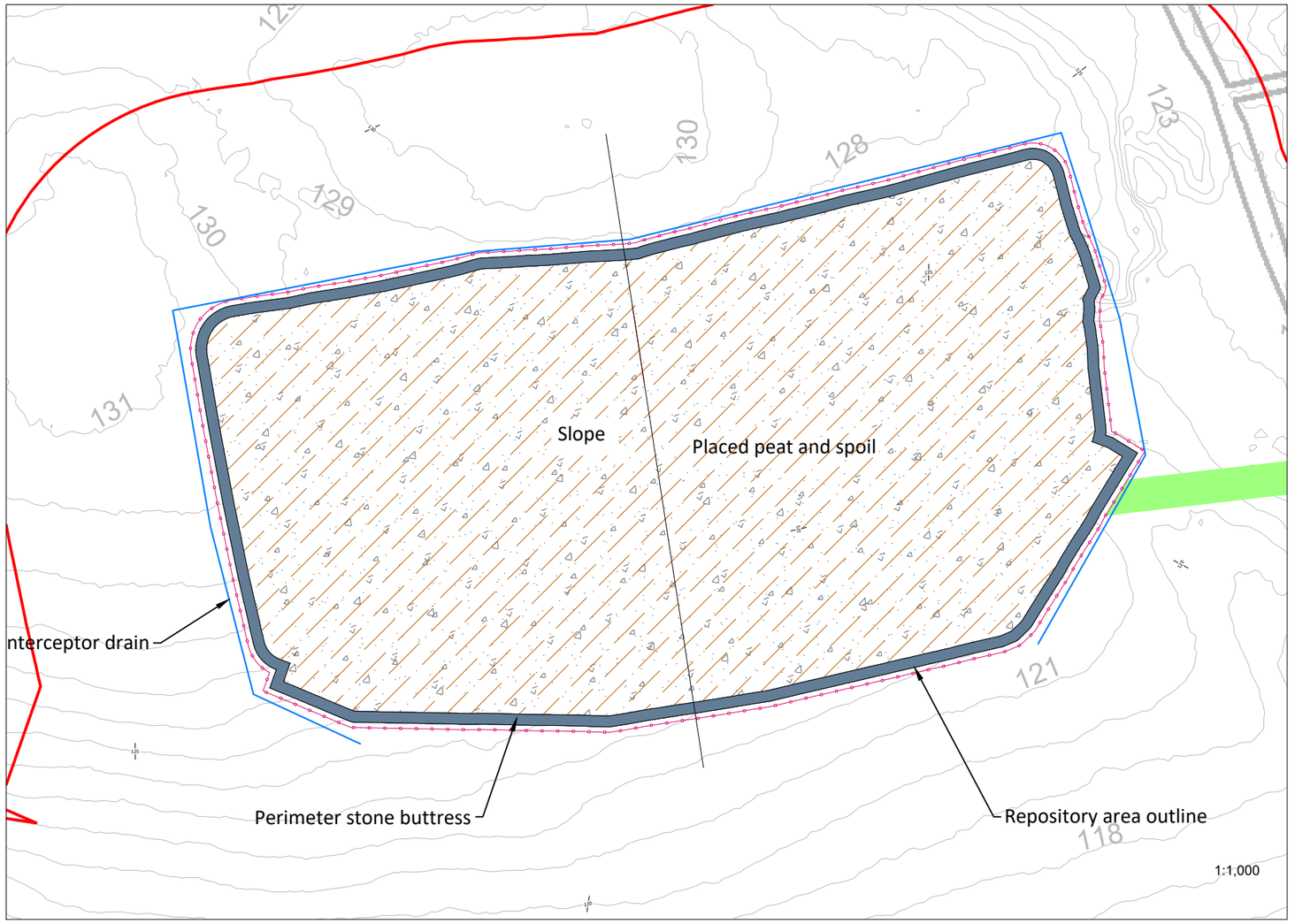
At certain turbine foundation and hardstand locations, depending on local ground conditions, the extraction of rock may be required in order to obtain a level construction area. Any rock obtained from a turbine location will be used to supply the hardcore materials requirement for that turbine's hardstand and access road.

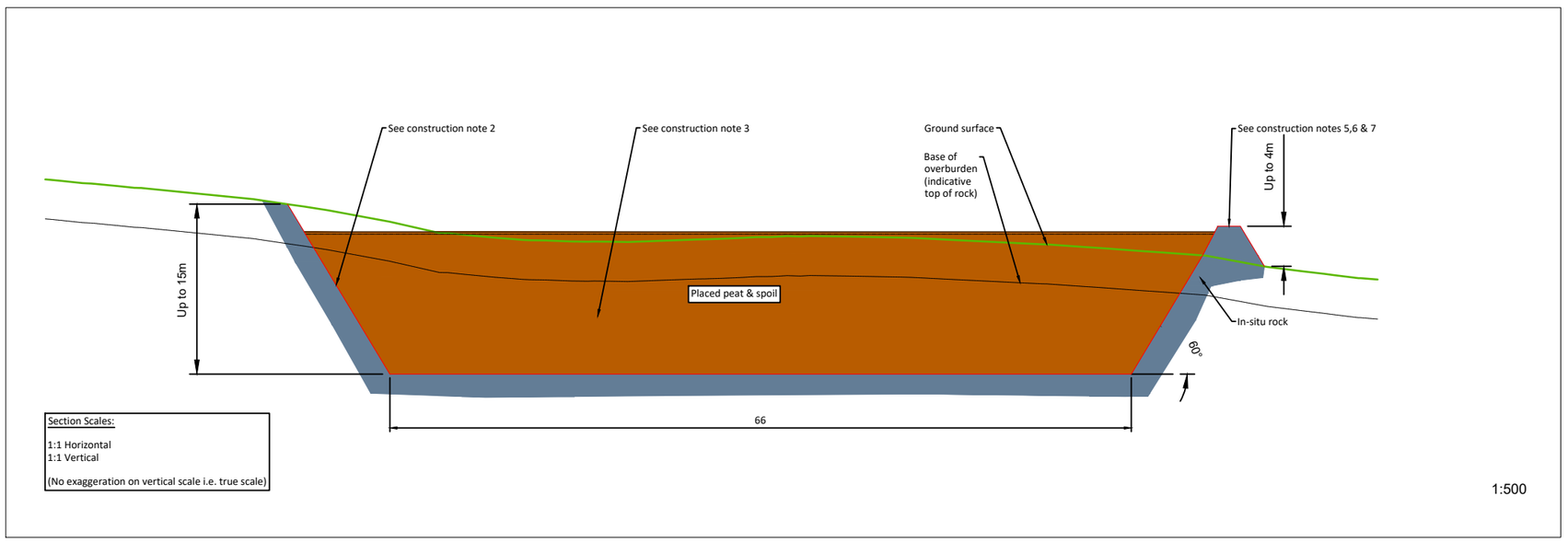
Hardcore materials will be extracted from the borrow pit (and some turbine locations, if necessary), principally by means of rock breaking. Depending on the hardcore volume requirements, blasting may also be used as a more effective rock extraction method, capable of producing significant volumes of rock in a matter of milliseconds. Blasting will only be carried out after notifying any potentially sensitive local residents. The potential noise and vibration impacts on sensitive receptors associated with the rock extraction measures, detailed below, are assessed in Chapter 12 of this EIAR.

The two proposed extraction methods are detailed below.

4.3.3.2 Rock Extraction Methods

The extraction of rock from the borrow pit is a work stage of the Proposed Development which will be a temporary operation run over a short period of time relative to the duration of the entire project. Where present, overburden will be stripped back and stockpiled using standard tracked excavators. Two extraction methods have been assessed for breaking out the useful rock below; rock breaking and blasting.





Construction Notes Borrow pit

(1) It is proposed to construct the borrow pit so that the base of the borrow pit is below the level of the adjacent section of access road. Depending on the type and condition of rock present in the borrow pit it may be possible to excavate the rock from the borrow pit whilst leaving in place upstands/segments of intact rock which will help to retain the placed peat & spoil. The upstands/segments of intact rock will essentially act as engineered rock buttresses within the borrow pit.

(2) Slopes within the excavated rock formed around the perimeter of the borrow pit should be formed at stable inclinations to suit local in-situ rock conditions.

(3) Infilling of the peat & spoil should commence at the back edge of the borrow pit and progress towards the borrow pit entrance/rock buttress. Excavation and infilling of the borrow pit will need to be sequenced and programmed. Leaving in place upstands/segments of intact rock which will help to retain the placed peat & spoil and will allow the borrow pit to be developed and infilled in cells.

(4) The contractor excavating the rock will be required to develop the borrow pit in a way which will allow the excavated peat & spoil to be reinstated safely.

(5) A rock buttress is required at the downslope edge of the borrow pit to safely retain the infilled peat and spoil. The height of the rock buttresses constructed should be greater than the height of the infilled peat & spoil to prevent any surface peat & spoil run-off. A buttress up to 7m (approx.) in height is likely to be required.

(6) The rock buttress will be founded on competent strata. The founding stratum for the rock buttress should be inspected and approved by a competent person.

(7) In order to prevent water retention occurring behind the buttresses, the buttresses should be constructed of coarse boulder fill with a high permeability.

(8) Where possible, the surface of the placed peat & spoil should be shaped to allow efficient run-off of surface water from the placed arising's.

(9) Control of groundwater within the borrow pit may be required and measures will be determined as part of the ground investigation programme.

(10) All the above-mentioned general guidelines and requirements should be confirmed by the designer prior to construction.

(11) Further guidelines on the construction of the borrow pit is included within Section 7.4 of the Peat & Spoil Management Plan

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Figure 4-9

DRAWING TITLE:
Borrow Pit 1 Layout & Section

PROJECT TITLE:
Cahermurphy Wind Farm, Co. Clare

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PROJECT No.: 170238	DRAWING No.: 170238 - 32
SCALE: As Shown @ A3	DATE: 14.07.2020

OS SHEET No.: 4315, 4316, 4317, 4318, 4373, 4374, 4375, 4376, 4431, 4432, 4333, 4334, 4490, 4491, 4492, 4493

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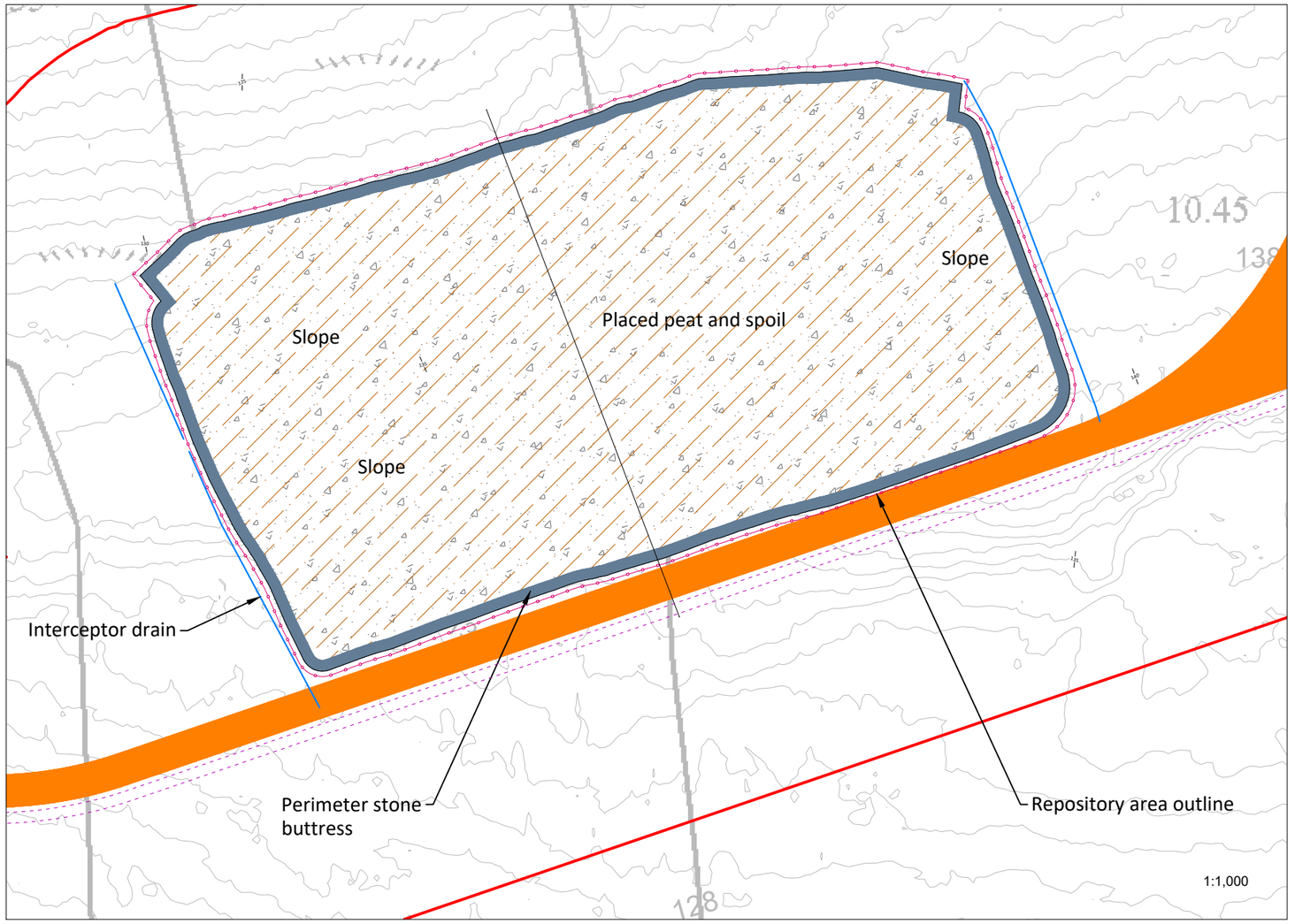

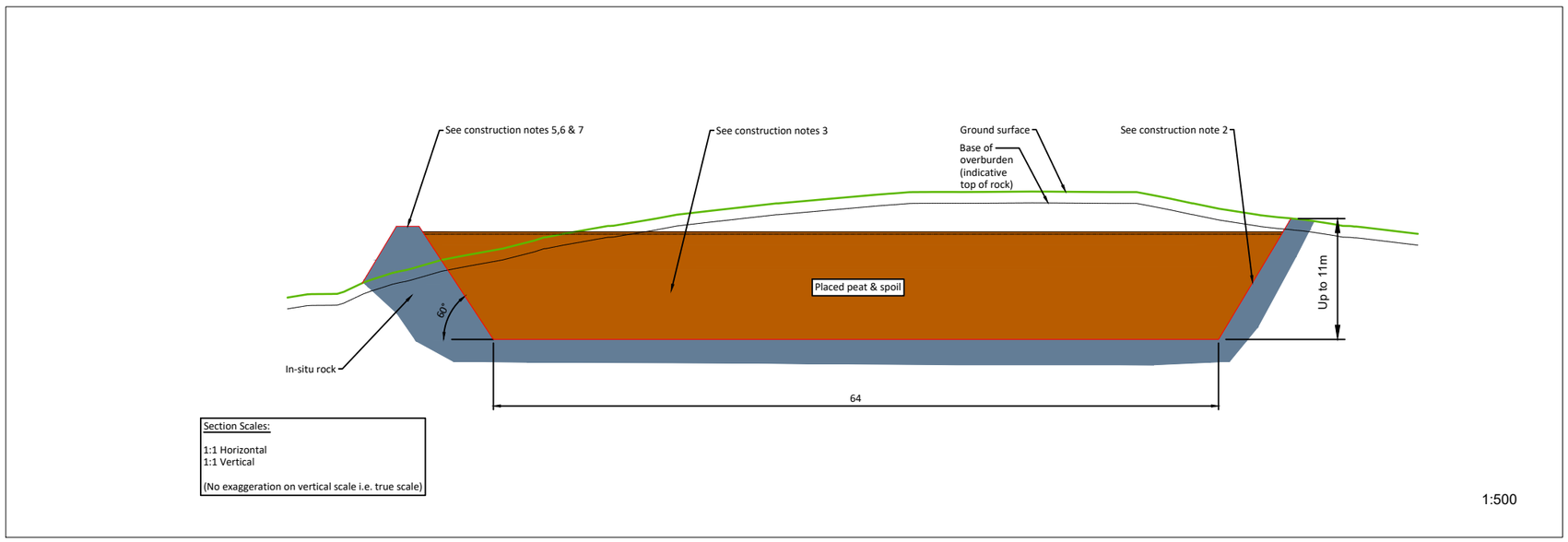

Construction Notes Borrow pit

(1) It is proposed to construct the borrow pit so that the base of the borrow pit is below the level of the adjacent section of access road. Depending on the type and condition of rock present in the borrow pit it may be possible to excavate the rock from the borrow pit whilst leaving in place upstands/segments of intact rock which will help to retain the placed peat & spoil. The upstands/segments of intact rock will essentially act as engineered rock buttresses within the borrow pit.

(2) Slopes within the excavated rock formed around the perimeter of the borrow pit should be formed at stable inclinations to suit local in-situ rock conditions.

(3) Infilling of the peat & spoil should commence at the back edge of the borrow pit and progress towards the borrow pit entrance/rock buttress. Excavation and infilling of the borrow pit will need to be sequenced and programmed. Leaving in place upstands/segments of intact rock which will help to retain the placed peat & spoil and will allow the borrow pit to be developed and infilled in cells.

(4) The contractor excavating the rock will be required to develop the borrow pit in a way which will allow the excavated peat & spoil to be reinstated safely.

(5) A rock buttress is required at the downslope edge of the borrow pit to safely retain the infilled peat and spoil. The height of the rock buttresses constructed should be greater than the height of the infilled peat & spoil to prevent any surface peat & spoil run-off. A buttress up to 7m (approx.) in height is likely to be required.

(6) The rock buttress will be founded on competent strata. The founding stratum for the rock buttress should be inspected and approved by a competent person.

(7) In order to prevent water retention occurring behind the buttresses, the buttresses should be constructed of coarse boulder fill with a high permeability.

(8) Where possible, the surface of the placed peat & spoil should be shaped to allow efficient run-off of surface water from the placed arising's.

(9) Control of groundwater within the borrow pit may be required and measures will be determined as part of the ground investigation programme.

(10) All the above-mentioned general guidelines and requirements should be confirmed by the designer prior to construction.

(11) Further guidelines on the construction of the borrow pit is included within Section 7.4 of the Peat & Spoil Management Plan

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N

Figure 4-10

DRAWING TITLE:
Borrow Pit 2 Layout & Section

PROJECT TITLE:
Cahermurphy Two Wind Farm, Co. Clare

DRAWING BY: POR	CHECKED BY: IH
PROJECT No.: 170238	DRAWING No.: 170238 - 37
SCALE: As Shown @ A3	DATE: 02.09.2020
OS SHEET No.: 4315, 4316, 4317, 4318, 4373, 4374, 4375, 4376, 4431, 4432, 4333, 4334, 4490, 4491, 4492, 4493	

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4.3.3.2.1 Rock Breaking

Weathered or brittle rock can be extracted by means of a hydraulic excavator and a ripper attachment. This is a common extraction methodology where fragmented rock is encountered as it can be carefully excavated in layers by a competent operator. In areas where rock of a much higher strength is encountered and cannot be removed by means of excavating then a rock breaking methodology may be used. Where rock breaking is required, a large hydraulic 360-degree excavator with a rock breaker attachment is typically used. Given the power required to break out tight and compact stone at depth, the machines are generally large and in the 40-60 tonne size range. Even where rock might appear weathered or brittle at the surface, the extent of weathering can quickly diminish with depth resulting in strong rock requiring significant force to extract it at depths of only a few metres.

A large rock breaking excavator progressively breaks out the solid rock from the ground in the borrow pit area. The large rock breaker is typically supported by a smaller rock breaker which can often be in the 30-40 tonne size range, and works to break the rocks down to a size that they can be fed into a crusher.

The extracted broken rock is typically loaded into a mobile crusher using a wheeled loading shovel, and crushed down to the necessary size of graded stone required for the on-site civil works. The same wheeled loader takes the stone from the crusher conveyor stockpile, and stockpiles it elsewhere away from the immediate area of the crusher until it is required elsewhere on the site of the Proposed Development.

4.3.3.2.2 Rock Blasting

Where blasting is used as an extraction method, a mobile drilling rig is used to drill vertical boreholes into the area of rock that is to be blasted. The drilling rigs used are normally purpose built, self-propelled machines, designed specifically for drilling blast boreholes. A drilling rig working for 3-4 days would typically drill the necessary number of boreholes required for a single blast. The locations, depth and number of boreholes are determined by the blast engineer, a specialist role fulfilled by the blasting contractor that would be employed to undertake the duties.

The blast engineer would then arrange for the necessary quantity of explosive to be brought to site to undertake a single blast. The management of explosives on site and the actual blasting operation would be agreed in advance with and supervised by An Gardaí Siochána. The blast engineer sets the explosives in place in the boreholes, sets the charges, and fires the blast. The blast takes only a matter of milliseconds, but may be perceived to take longer as blast noise echoes around the area.

A properly designed blast should generate rock of a size that can be loaded directly into a mobile crusher, using the same wheeled loader description outlined above. From that point on, the same method is used for processing the rock generated from a blast, as would be used to process rock generated by rock breaking. It would be likely that a drilling rig would recommence drilling blast holes for the next blast as soon one blast finished. Rock blasting will be undertaken in line with the Safety and Health Commission for the Mining and other Extractive Industries report on *Guidance on the Safe Use of Explosives in Quarries* to ensure the safe use of explosives on-site. Only authorised people will handle explosives for rock blasting at the site. Given the small quantities of explosives to be used on site, it is considered that there is negligible risk of a major accident occurring from the use of explosives on site. The potential impacts associated with noise are assessed in Chapter 12 Noise and Vibration.

4.3.4 Peat and Spoil Management Plan

4.3.4.1 Quantities

The quantity of peat and non-peat material (spoil), requiring management on the site of the Proposed Development has been calculated, as presented in Table 4-2 below. These quantities were calculated by FTC) as part of the *Peat and Spoil Management Plan* in Appendix 4-2 of this EIAR.

Table 4-2 Peat and Spoil Volumes requiring management

Development Component	Area (m2) (approx.)	Peat Volume (m3) (approx.)	Spoil Volume(m3) (approx.)
10 no. Turbines and Hardstanding Areas	23,050	26,415	16,757
1 no. Construction Compound Platform	3,287	1,968	4,195
Option A - 1 no. Substation Platform & Building	3,133	648	
Option B – 1 no. Substation Platform & Building	3,095	3,456	
Anemometry Mast Platform	294	283	
Access Roads	Assumed 5m running surface with 6m wide development footprint	45,322	103,320
2 no. Borrow Pits	25,900	9,900	37,450
Total		**87,992**	**161,722**
Total Peat & Spoil to be managed		**249,714**	

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.

4.3.4.2 Peat and Spoil Usage in Restoration of Borrow Pits

Once the required volume of rock has been extracted from the borrow pit areas, it is intended to reinstate these areas with peat and overburden excavated from the works areas of the Proposed Development.

The general construction methodology for the construction of the borrow excavated roads, as presented in FTC's *Peat & Spoil Management Plan* in Appendix 4-2 of this EIAR, is summarised below. This

methodology includes procedures that are to be included in the construction to minimise any adverse impact on peat stability.

As rock is being extracted from the borrow pit, upstands of rock will be left in place, depending on the type of rock, to act as intermediate retaining buttresses. Where this is not achievable, stone buttresses will be constructed within the borrow pit. The upstands or buttresses will form individual restoration areas within the borrow pit which will be filled once the required volume of rock has been extracted from each individual area. The buttresses will be wide enough to allow construction traffic access for the tipping of peat into the individual cells.

A temporary access track, will be placed around the perimeter of the borrow pit area to allow for the tipping of peat over the edge of the borrow pit area.

Where possible, the acrotelm peat that has been excavated and not retained for reinstatement and landscaping works will be stored with the vegetated side facing up so as to promote the growth of vegetation across the surface of the stored peat within the borrow pit area.

4.3.4.2.1 Placement of Peat & Spoil alongside Access Roads

In some areas of the site of the Proposed Development excavated materials will be placed alongside the access roads. The following recommendations/best practice guidelines for the placement of peat and spoil alongside the access road will be adhered to during the construction of the Proposed Development:

1. *The potential spoil placement area locations identified are alongside the proposed access roads in the central area of the site where the topography is typically flat. The placement of spoil alongside the access roads will be restricted to areas where the peat depth is less than 3m.*

2. *Given the relatively flat topography present in the central part of the site, the placement of peat & spoil alongside the access roads is deemed appropriate.*

3. *The peat & spoil placed adjacent to the new proposed access roads will be restricted to a maximum height of 1m over a 10m wide corridor on both sides of the access road. It should be noted that the designer should define/confirm the maximum restricted height for the placed peat & spoil within the maximum corridor.*

4. *The placement of excavated peat & spoil is to be avoided without first confirming the adequacy of the ground to support the load. The placement of peat & spoil within the placement areas will likely require the use of long reach excavators, low ground pressure machinery and possibly bog mats in particular for drainage works.*

5. *Where there is any doubt as to the stability of the peat surface then no material shall be placed on to the peat surface. The risk of peat instability is reduced by not placing any loading onto the peat surface.*

6. *Where practical, it should be ensured that the surface of the placed peat & spoil is shaped to allow efficient run-off of surface water. Where possible, shaping of the surface of the peat & spoil will be carried out as placement of peat & spoil within the placement area progresses. This will reduce the likelihood of debris run-off and ensure stability of the placed peat & spoil.*

7. *Finished/shaped side slopes in the placed peat & 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 & spoil are encountered then slacker slopes will be required.*

8. *Where possible, the acrotelm shall be placed with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation at the surface of the placed peat & spoil within the placement areas.*

9. *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.*

10. *Supervision by a geotechnical engineer or appropriately competent person of the works will occur.*

11. *An interceptor drain will be installed upslope of the designated peat placement areas to divert any surface water away from these areas. This will help ensure stability of the placed peat and reduce the likelihood of debris run-off.*

12. *All the above mentioned general guidelines and requirements will be confirmed and employed by the designer prior to construction.*

The management of excavated peat and overburden and the methods of placement and/or reinstatement are described in detail in FTC's *Peat and Spoil Management Plan* in Appendix 4-2 of this EIAR.

4.3.5 Electricity Substation

It is proposed to construct one 38 kV electricity substation within the site, at one of two locations (Option A or B as set out in Section 4.1 above) as shown in Figure 4.1. The layouts and elevations of the proposed substation options are shown on Figure 4-11, Figure 4-12 and Figure 4-13. The construction and electrical components of the electricity substations will be to Eirgrid specifications. Further details regarding the connection between the site substations themselves and then on to the national electricity grid are provided in Section 4.3.7 of this EIAR chapter. The footprint of the proposed onsite electricity substation compound measures approximately 2,143 square metres, and will include a wind farm control building and the electrical substation components necessary to consolidate the electrical energy generated by each wind turbine, and export that electricity from the wind farm substation to the national grid. The onsite substation will be a permanent development under the ownership of the ESB/EirGrid.

The substation compound will be surrounded by an approximately 2.4 metre high steel palisade fence (or as otherwise required by ESB), and internal fences will also segregate different areas within the main substation.

4.3.5.1 Wind Farm Control Buildings

A wind farm control building will be located within whichever substation compound is constructed, within the substation compound. The control building will measure 21.5 metres by 7.3 metres and 6 metres in height. Layout and elevation drawings of the control building are included in Figure 4-14.

The wind farm control building 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 harvest rainwater from the roofs of the buildings, and if necessary, bottled water will be supplied for drinking.

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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
- Existing Road to be Upgraded
- Proposed Road
- Electrical Cable Trench
- Cable Route
- Cut
- Fill

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Figure 4-11

DRAWING TITLE:
Substation Layout - Option A

PROJECT TITLE:
Cahermurphy Wind Farm, Co. Clare

DRAWING BY:	CHECKED BY:
Joseph O Brien	Michael Watson
PROJECT No.: 170238	DRAWING No.: 170238 - 27
SCALE: 1:500 @ A3	DATE: 14.07.2020

OS SHEET No.: 4315, 4316, 4317, 4318, 4373, 4374, 4375, 4376, 4431, 4432, 4333, 4334, 4490, 4491, 4492, 4493

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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
- Existing Road to be Upgraded
- Electrical Cable Trench
- Cable Route
- Cut
- Fill

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Figure 4-12

DRAWING TITLE:
Substation Layout - Option B

PROJECT TITLE:
Cahermurphy Two Wind Farm, Co. Clare

DRAWING BY:	CHECKED BY:
Joseph O Brien	Eoin O Sullivan
PROJECT No.: 170238	DRAWING No.: 170238 - 32
SCALE: 1:500 @ A3	DATE: 02.09.2020

OS SHEET No.: 4315, 4316, 4317, 4318, 4373, 4374, 4375, 4376, 4431, 4432, 4333, 4334, 4490, 4491, 4492, 4493

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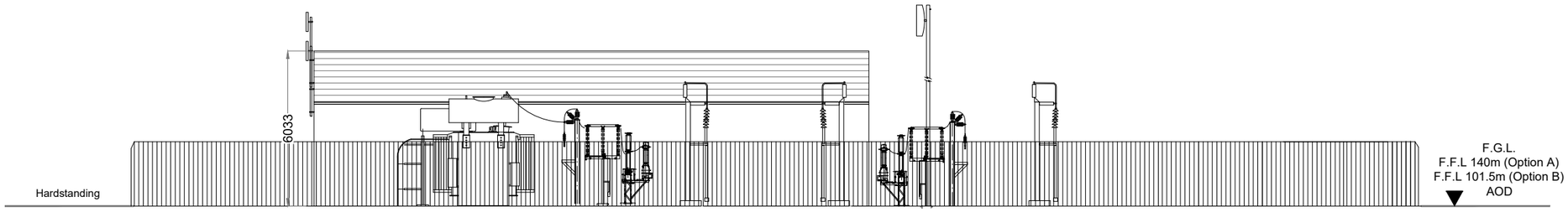
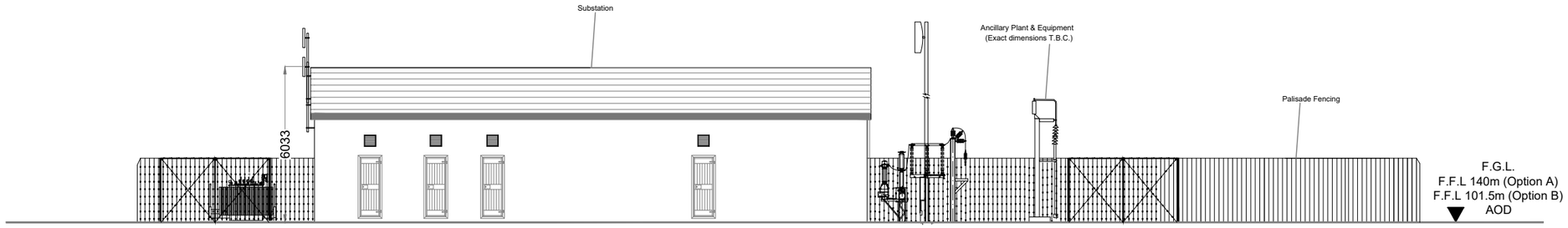
Drawing Notes

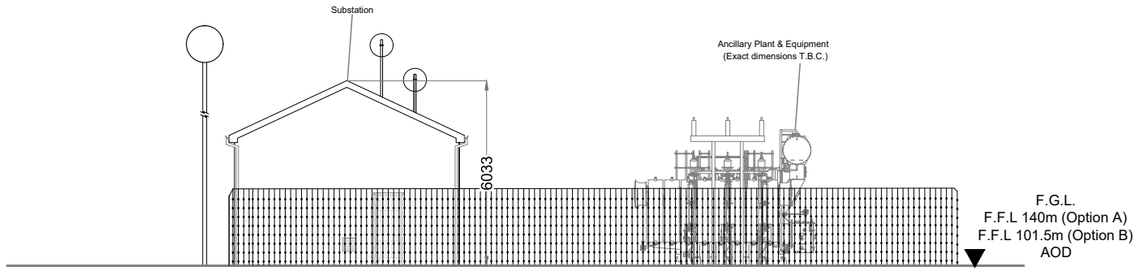
1. Layout and arrangements of substation buildings and electrical equipment is shown indicatively and for illustration purposes only as final specifications of buildings and electrical equipment is to be dictated by Eirgrid/ESB networks requirements.



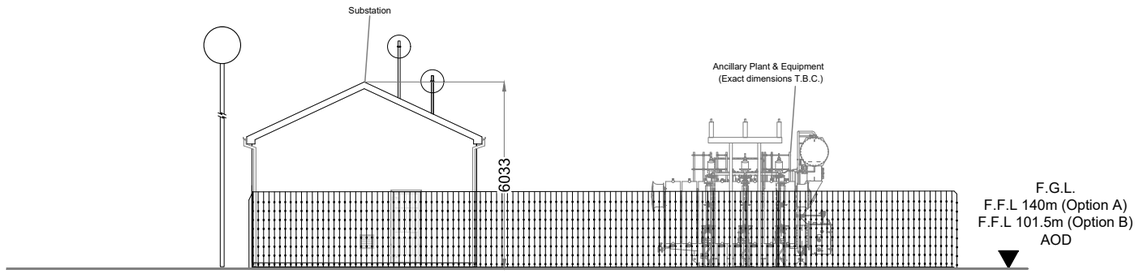
Eastern Elevation



Western Elevation



Northern Elevation



Southern Elevation

Figure 4-13

DRAWING TITLE:

Substation Elevations

PROJECT TITLE:

Cahermurphy Two Wind Farm, Co. Clare

DRAWING BY:	CHECKED BY:
Joseph O Brien	**Eoin O Sullivan**
PROJECT No.: **170238**	DRAWING No.: **170238 - 33**
SCALE: **1:200 @ A3**	DATE: **02.09.2020**

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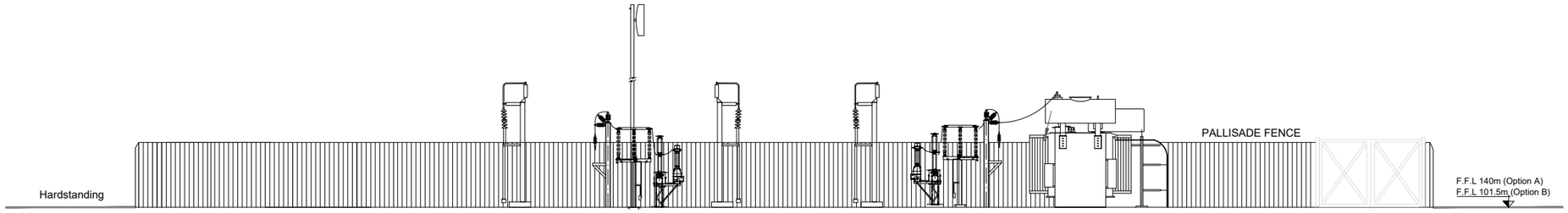
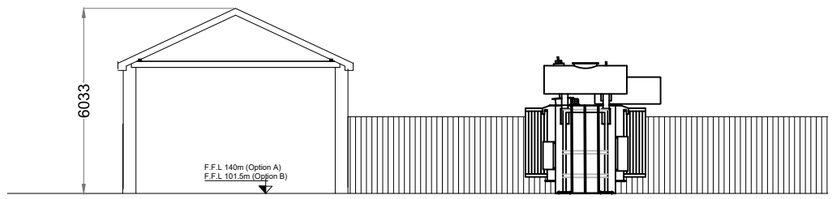


Site Cross Section A-A



Site Cross Section 1-1

Figure 4-13

DRAWING TITLE:
Substation Sections

PROJECT TITLE:
Cahermurphy Two Wind Farm, Co. Clare

DRAWING BY:	CHECKED BY:
Joseph O Brien	Eoin O Sullivan
PROJECT No.: 170238	DRAWING No.: 170238 - 34
SCALE: 1:200 @ A3	DATE: 02.09.2020

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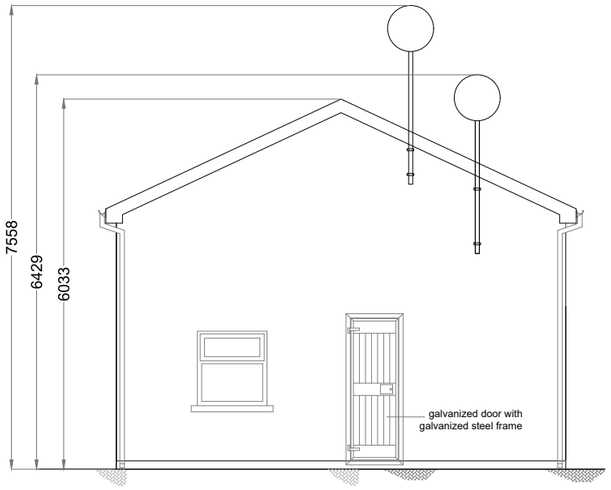
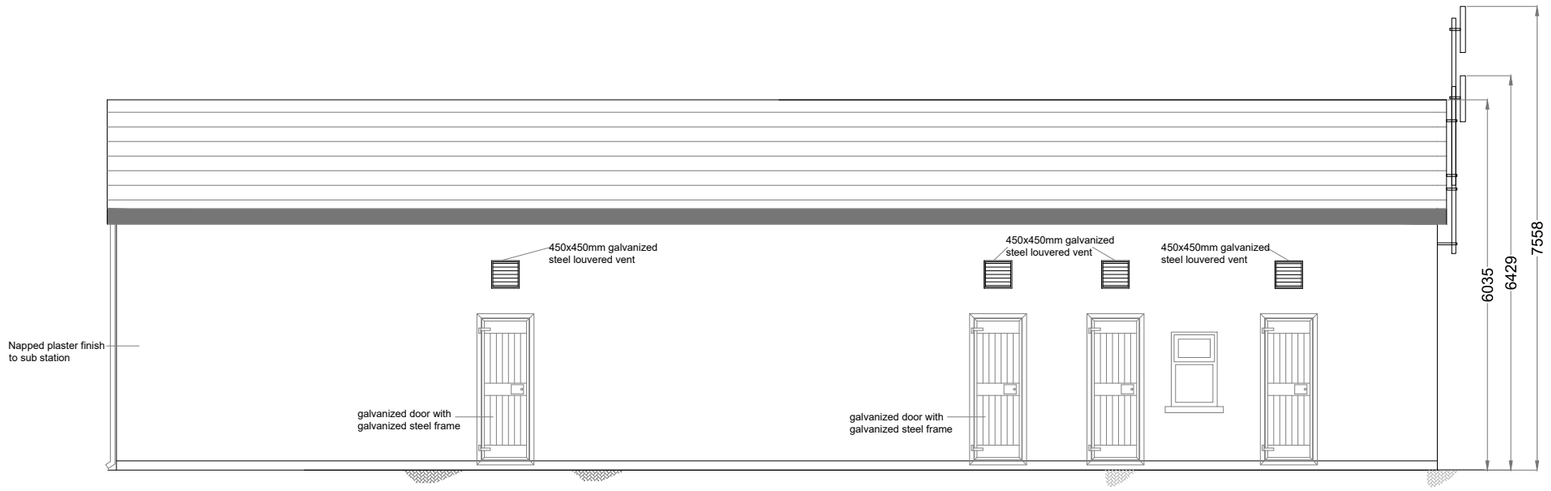
Drawing Notes

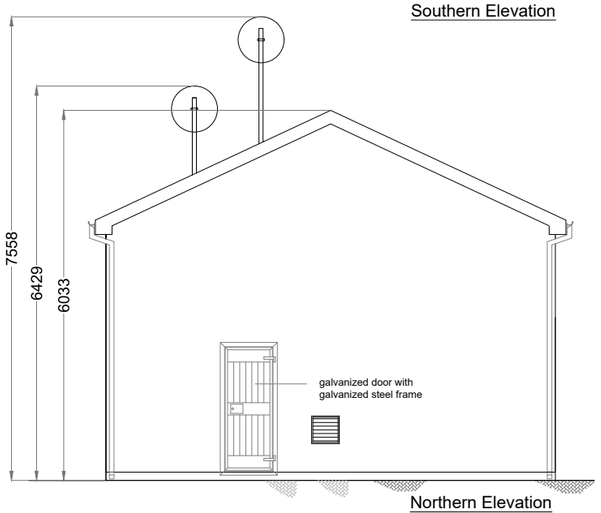
1. Layout and arrangements of substation buildings and electrical equipment is shown indicatively and for illustration purposes only as final specifications of buildings and electrical equipment is to be dictated by Eirgrid/ESB networks requirements.



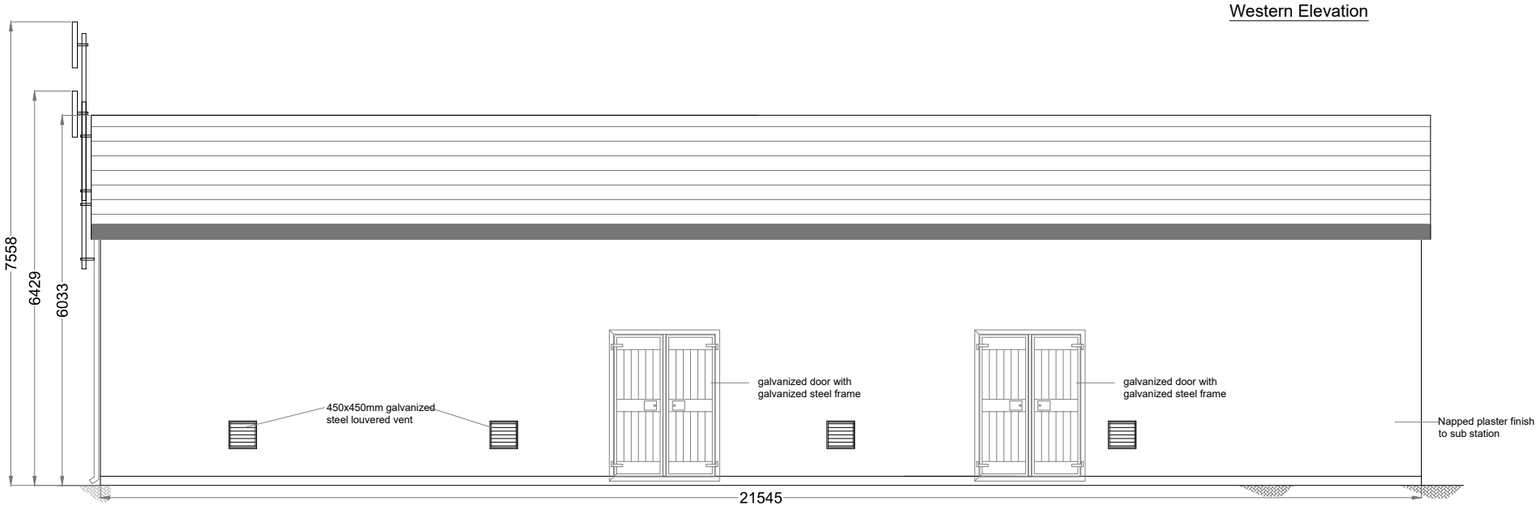
Southern Elevation



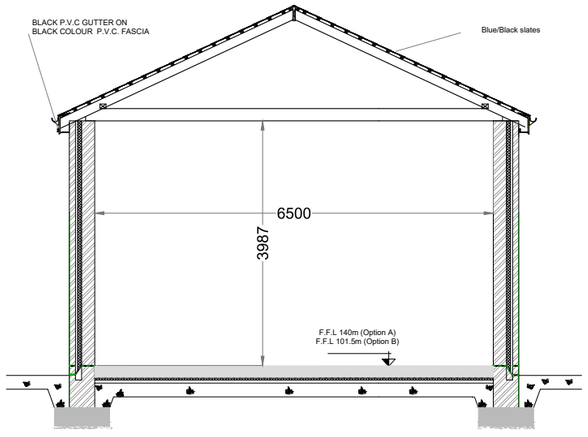
Western Elevation



Northern Elevation

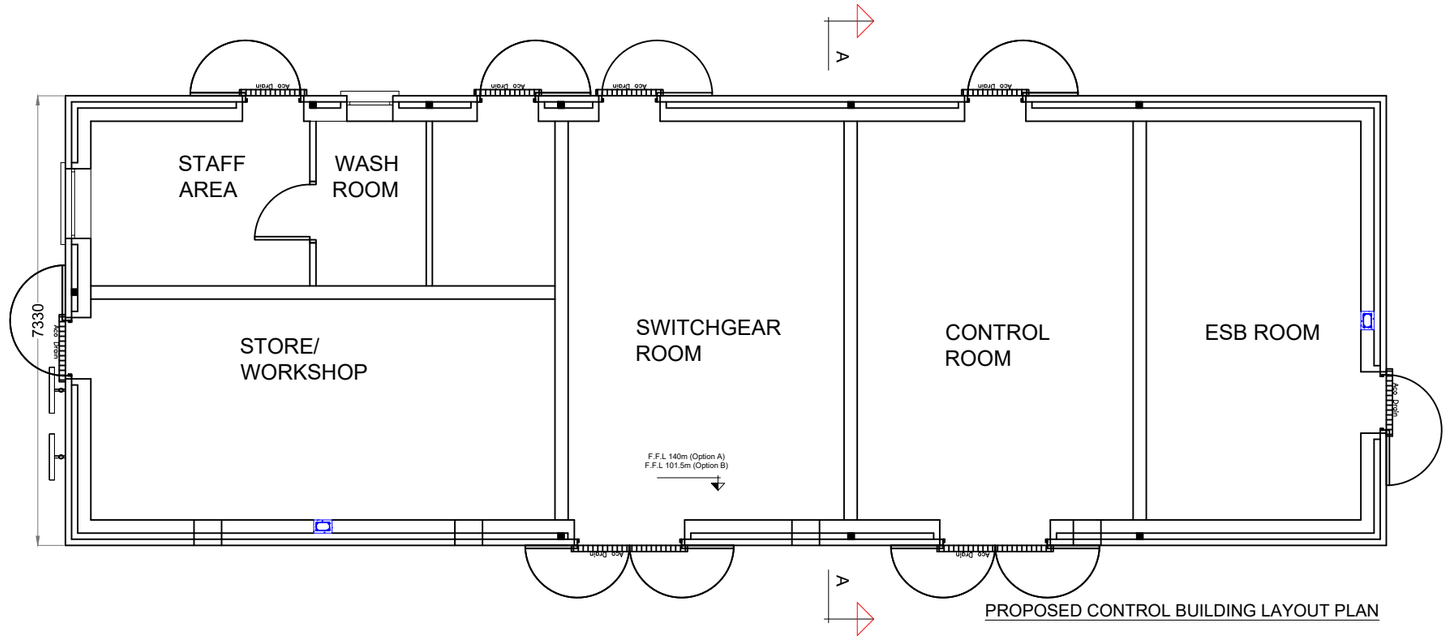


Eastern Elevation



Section
a-a

SECTION A-A



PROPOSED CONTROL BUILDING LAYOUT PLAN

Figure 4-14

DRAWING TITLE:
Typical Control Building Elevations & Section

PROJECT TITLE:
Cahermurphy Two Wind Farm, Co. Clare

DRAWING BY:	CHECKED BY:
Joseph O Brien	Eoin O Sullivan
PROJECT No.: 170238	DRAWING No.: 170238 - 35
SCALE: 1:100 @ A3	DATE: 02.09.2020

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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 permitted 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 (p.e. 10)' 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. 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 to a licensed facility.

4.3.6 Site Cabling

Each turbine will be connected to the on-site electricity substation via an underground 20 or 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 roadways. The route of the cable ducts will follow the access track to each turbine location, and are visible on the site layout drawings included as Appendix 4.1 to this report. Figure 4-15 below shows two variations of a typical cable trench, one for off-road trenches (to be installed on areas of soft ground that will not be trafficked) and one for on-road trenches (to be used where trenches run along or under a roadway).

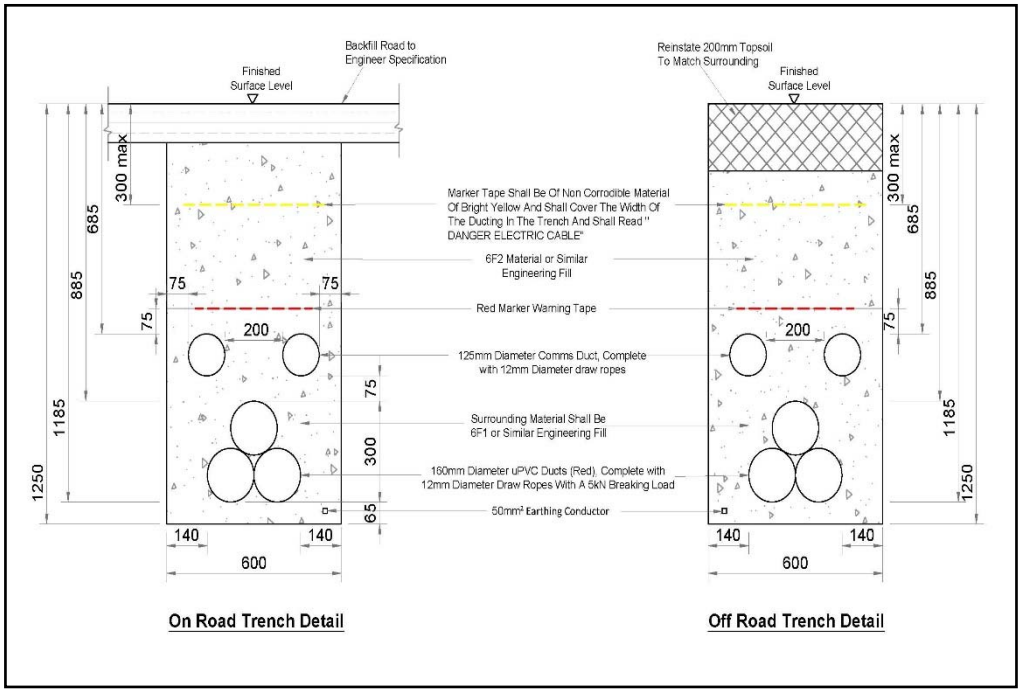

Figure 4-15 Typical Cable trench cross-section detail

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.

4.3.7 Grid Connection Cabling

A connection between the proposed development site and the national electricity grid will be necessary to export electricity from the proposed wind farm.

There are 2 No. substations options; however, only one substation will ultimately be constructed. This is to allow the national grid operator, ESB/Eirgrid flexibility when deciding on which is technically preferable from their perspective.

The proposed wind farm will connect to the grid via one of the following methods:

- Option A: It is proposed to construct a 38 kV substation at the northern end of the site and to connect from here to the existing Booltiagh 110kV substation, located approximately 7 kilometres to the southeast of the site. Option A also includes for an alternative cable route running from the proposed onsite substation south to the access road and north along the local road to the east of the site. The alternative cable route option measures approximately 1.7 km in length. Connection via the Booltiagh route would comprise underground cabling, measuring approximately 12.1 km in total, located on existing forestry and agricultural land and within the public road corridorr.

Or

- Option B: It is proposed to construct a 38kvV substation at the south eastern end of the site and to connect from here to the existing Booltiagh 110kV substation, located approximately 7 kilometres to the southeast of the site. Connection via the Booltiagh route would comprise underground cabling, measuring approximately 12.1 km in total, located on existing forestry and agricultural land and within the public road corridor.

The exact final detail and specifications of the grid connection route for the Proposed Development in accordance with the parameters described and assessed in this EIAR, will ultimately be confirmed by ESB/EirGrid.

This connection routes are illustrated in Figure 4-16.

4.3.8 Meteorlogical Mast

One permanent metrological mast is proposed as part of the Proposed Development. The metrological mast will be equipped with wind monitoring equipment at various heights. The mast will be located at E508103 N668407 as shown on the site layout drawing in Figure 4-1. The mast will be a self-supporting slender structure up to 100 metres in height. The mast 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 metrological mast is shown in Figure 4-17.

4.3.9 Temporary Construction Compound

A temporary construction compound measuring approximately 73 metres by 45 metres and 3,300 square metres in area is proposed for the centre of the site, adjacent to the existing access road approximately 100 metres to the northwest of Turbine No. 5. The location of the proposed construction compound is shown on the site layout drawing in Figure 4-1.

The construction compound will consist of temporary site offices, staff facilities and car-parking areas for staff and visitors. The layout of this construction compound is shown on Figure 4-18. 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 permitted waste collector to wastewater treatment plants.

4.3.10 Tree Felling and Replanting

4.3.10.1 Tree Felling

Some of the proposed wind farm site and grid connection route is occupied by commercial forestry. As part of the Proposed Development, tree felling will be required within and around the development footprint to allow the construction of turbine bases, access roads, grid connection and the other ancillary infrastructure.

It should be noted that forestry on the site of the proposed wind farm and along the route of the grid connection was originally planted as a commercial crop and will be felled in the future should the proposed wind farm proceed or not.

A total of 34.11 hectares of forestry will have to be permanently felled for the proposed development. This includes a total of 27.6 hectares within and around the footprint of the Proposed Development and 6.51 hectares along the grid connection route. Figure 4-19 and Figure 4-20 shows the extent of the areas to be felled as part of the Proposed Development.

The tree felling activities required as part of the proposed development will be the subject of a Felling Licence application to the Forest Service, in accordance with the Forestry Act 2014, the Forestry Regulations 2017 (SI 191/2017) and as per the Forest Service's policy on granting felling licenses for wind farm developments. The policy requires that a copy of the planning permission for the wind farm be submitted with the felling licence applications; therefore the felling licenses cannot be applied for until such time as planning permission is obtained for the proposed development.

Map Legend

- EIAR Study Boundary
- Proposed Turbine Location
- Proposed Grid Connection
- Alternative Grid Connection Option
- Booltiagh 110kV Substation
- Proposed onsite Substation Locations

Doo Lough
Loch Dúlocha
Creevagh
Creevagh Lough
Treanmanagh
Carrownagry
Cillín
Drummin Br
Illaunfreega Br
Cragbeg Br
Sch
Boleybeg Lough
Doolough Br
Doolough
Holy Well
Megalithic Tomb
Carncreagh
Drummin
Knockadrummin
Lough Nacrag
Cragnashingaun
Gortaheera
Cahermurphy
Caheraghacullin
Cahermurphy Hill
Cloonwhite North
Clooneenagh Cross
Graveyard
Castlepark
Cahermurphy Lough
Castle
Cloonwhite South
Mound
Knockbrack
Cairn
Holy Well
Kiltumper
Mound
Ford
Sch
Clonigulane
Lisbane
Glenmore
Illaunatoo or Sorrelisland
Sorrel Island Br
Boolynamweel
Megalithic Tomb
1
2
3
4
5
6
7
8
9
10
N
W
E
S

MAP TITLE: **Proposed Grid Connection Route**		MAP NO.: **Figure 4.16**	SCALE: **1:25,000**
PROJECT TITLE: **Cahermurphy Two Wind Farm**			DATE: **01-09-2020**
DRAWING BY: **Eoin O'Sullivan**	CHECKED BY: **Michael Watson**	ISSUE NO.: **170238-2020.09.01-D7**	

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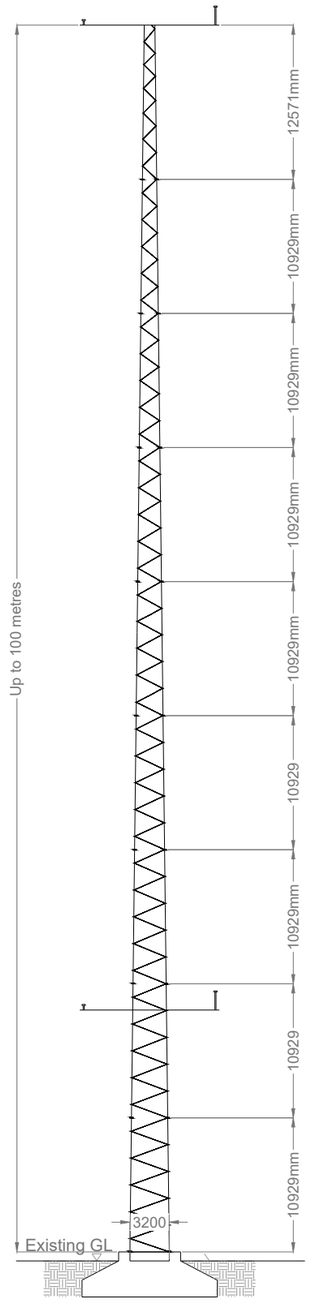
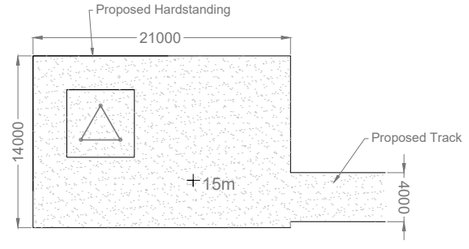
Drawing Notes

1. Met mast on site will either be guyed met mast or free standing met mast depending on site conditions. Both options shown only one will be used.





Met Mast Compound Plan

N

Figure 4-17

DRAWING TITLE:

Free Standing Met Mast

PROJECT TITLE:

Cahermurphy Two Wind Farm, Co. Clare

DRAWING BY:	CHECKED BY:
Joseph O Brien	Eoin O Sullivan
PROJECT No.: 170238	DRAWING No.: 170238 - 38
SCALE: 1:500 @ A3	DATE: 02.09.2020

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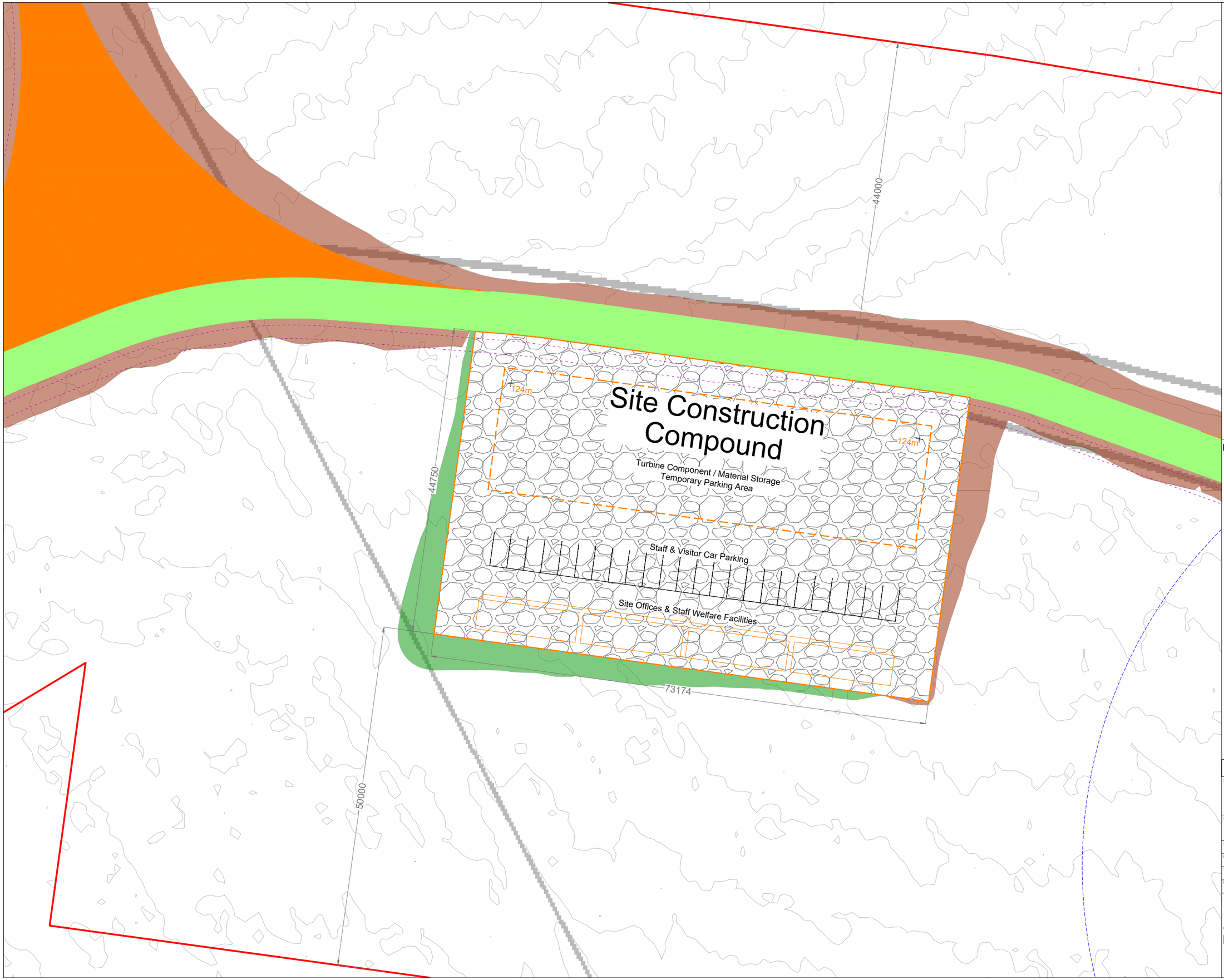

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4. Do not scale off this drawing. Figured metric dimensions only should be taken off this drawing.
5. All contractors, whether main or sub-contractors, must visit the site and are responsible for taking and checking any and all dimensions and levels that relate to the works.
6. The use of or reliance upon this drawing shall be deemed to be acceptance of these conditions of use unless otherwise agreed in writing, such written agreement to be sought from and issued by the copyright holder to the use or reliance upon this drawing.
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
- Existing Road to be Upgraded
- Proposed Road
- Turbine Sweep Area
- Electrical Cable Trench
- Cut
- Fill

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N

Figure 4-18

DRAWING TITLE:
Temporary Construction Compound

PROJECT TITLE:
Cahermurphy Two Wind Farm, Co. Clare

DRAWING BY:	CHECKED BY:
Joseph O Brien	Eoin O Sullivan
PROJECT No.: 170238	DRAWING No.: 170238 - 29
SCALE: 1:500 @ A3	DATE: 02.09.2020
OS SHEET No.: 4315, 4316, 4317, 4318, 4373, 4374, 4375, 4376, 4431, 4432, 4333, 4334, 4490, 4491, 4492, 4493	

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Map Legend

- EIAR Study Boundary
- Proposed Turbine Location
- Felling Area for Wind Farm Development (27.6 hectares)

Knocknahila
Drummin
Knockadrummin
Caheraghacullin
Gortaheera
Cahermurphy
Cahermurphy Hill
Cloonwhite North
loghaun
Sch

MAP TITLE: **Proposed Felling Area (Permanent Footprint)**		MAP NO.: **Figure 4.19**	SCALE: **1:12,000**
PROJECT TITLE: **Cahermurphy Two Wind Farm**			DATE: **13-07-2020**
DRAWING BY: **Eoin O'Sullivan**	CHECKED BY: **Michael Watson**		ISSUE NO.: **170238-2020.07.13-D5**

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Map Legend

- EIAR Study Boundary
- Felling Area for Grid Connection Development (6.51 hectares)

MAP TITLE: **Cable Route Felling Area**		MAP NO.: **Figure 4.20**	SCALE: **1:25,000**
PROJECT TITLE: **Cahermurphy Two Wind Farm**			DATE: **18-08-2020**
DRAWING BY: **Eoin O'Sullivan**	CHECKED BY: **Michael Watson**		ISSUE NO.:**170238-2020.08.18-D5**
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4.3.10.2 Forestry Replacement

In line with the Forest Service's published policy on granting felling licences for wind farm developments, areas cleared of forestry for turbine bases, access roads, and any other wind farm-related uses will have to be replaced by replanting at an alternative site.

A total of 34.11 hectares of new forestry will be replanted as a condition of any felling licence that might issue in respect of the proposed development. Replanting is a requirement of the Forestry Act and is primarily a matter for the statutory licensing processes that are under the control of the Forest service.

The replacement replanting of forestry can occur anywhere in the State subject to licence. Four potential replanting areas, listed in Table 4-3 have been identified for assessment purposes, with a combined availability of 36.72 hectares. These lands have been granted Forest Service Technical Approval for afforestation (or are awaiting new Technical Approvals), and these or similarly approved lands will be used for replanting should the proposed wind farm receive planning permission. A description of the proposed replanting lands and an assessment of the potential impacts including cumulative impacts associated with afforestation at each location are provided in Appendix 4-3 of this EIAR. A cumulative assessment is also included in each chapter of this EIAR.

Table 4-3 Proposed Replanting Lands

Location No.	Property Name	Location	Technically Approved Area (hectares)
1	Brackloon	Co. Roscommon	7.2
2	Cooraclare	Co. Clare	7.26
3	Pollnabrone	Co. Galway	9.69
4	Stranamart	Co. Cavan	12.57
Total Area Available			**36.72**

4.3.11 Habitat Enhancement Areas

A Hen Harrier and Peatland Habitat Enhancement Plan (HHPEP) has been prepared for the proposed development and is provided in Appendix 8-8 of the EIAR. The area proposed for the HHPEP is an undulating hilly site of c. 28.2 hectares. The area proposed for HHPEP is located approximatley 700 metres from the hen harrier territory to the south of Doo Lough. The selected farmland enhancement area is approximately 1.5 kilometres from the hen harrier territory at Doo Lough. The selected enhancement areas are located significantly closer to the Doo Lough territory than the foraging habitat that will be potentially lost at the proposed development area. The area is currently dominated by commercial forestry and contains crags with remnant stands of heather. The reports listed above should be consulted for detailed information on the proposals, however a brief summary of the key information is provided below.

Management prescriptions to be implemented by the applicant include:

- Forestry and brash will be removed on the site and the area will be allowed to revert to open peatland habitat. Pre-mature felling of forestry will be undertaken in accordance with a felling licence, before the first breeding season of the construction phase of the project programme.

This would allow time for the clear-felled site to revegetate in advance of the operational phase.
- Reinstatement of livestock proof fencing.
- Re-vegetation with native vegetation is therefore expected to occur naturally within the enhancement area.
- Forestry drainage channels will be blocked, using peat dams or plastic dams, as appropriate. In flat areas drain blocks should be placed every 15m and more frequently when accounting for a slope.
- Habitat maintenance of the enhancement area will involve the eradication of self-seeding conifers, and removal off-site. It is envisaged that the enhancement areas will require maintenance twice during the life of the wind farm, once during the construction phase and once after approximately 12 years.
- In the event of any invasive species being recorded within the area identified for enhancement measures, an invasive species management plan will be put in place to eradicate any stands of such species. A pre-commencement survey for invasive species to confirm the conditions predicted in this EIAR will be undertaken as part of preparatory work and if recorded an Invasive species management plan shall be prepared.
- Enhancement and maintenance works will be undertaken outside of the nesting season as per the Wildlife Act 1976, as amended.

In addition to the enhancement plan, local landowners have been engaged in a programme to farm in a hen harrier friendly manner. An area of c. 30 hectares of farmland has been identified for enhancement measures. This area is located 1.5km from the traditional hen harrier territory to the south of Doo Lough.

4.3.12 Site Activities

4.3.12.1 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 4-4 of this EIAR. The CEMP includes details of drainage, peat and overburden management and waste management. In the event planning permission is granted for the Proposed Development, the CEMP will be updated prior to the commencement of the development, to address the requirements of any relevant planning conditions, including any additional mitigation measures which are conditioned and will be submitted to the Planning Authority for written approval.

4.3.12.2 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.

4.3.12.3 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 (https://www.siltbuster.co.uk/sb_prod/siltbuster-roadside-concrete-washout-rcw/) 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 can be disposed of off-site at an appropriate 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 Plate 4-3 and Plate 4-4 below.

Plate 4-3 Concrete washout area

Plate 4-4 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 a high 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 discussed with suppliers before work starts, confirming routes, prohibiting on-site washout and discussing 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.

4.3.12.4 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 may 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 for freshly placed concrete to avoid the surface washing away in heavy rain.
- 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 (https://www.siltbuster.co.uk/sb_prod/siltbuster-roadside-concrete-washout-rcw/) or equivalent.
- Disposing of surplus concrete after completion of a pour in suitable off-site locations away from any watercourse or sensitive habitats.

4.3.12.5 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.

4.3.12.6 Vehicle Washing

Wheels or vehicle underbodies are often washed before leaving sites to prevent the build-up of mud on public (and site) roads. It is not anticipated that vehicle or wheel washing will be required as part of the construction phase of the Proposed Development because site roads will be already formed using on-site materials 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.

A road sweeper will be available if any section of the public roads were to be dirtied by trucks associated with the Proposed Development.

4.3.12.7 Waste Management

The CEMP, Appendix 4-4 of this EIAR, provides a waste management plan (WMP) which outlines the best practice procedures during the excavation and construction phases of the project. The WMP will

outline the methods of waste prevention and minimisation by recycling, recovery and reuse at each stage of construction of the proposed development. Disposal of waste will be seen as a last resort.

The Waste Management Act 1996 and its subsequent amendments provide for measures to improve performance in relation to waste management, recycling and recovery. The Act also provides a regulatory framework for meeting higher environmental standards set out by other national and EU legislation.

The Act requires that any waste related activity has to have all necessary licenses and authorisations. It will be the duty of the Waste Manager on the site of the development to ensure that all contractors hired to remove waste from the site have valid Waste Collection Permits. It will then be necessary to ensure that the waste is delivered to a licensed or permitted waste facility. The hired waste contractors and subsequent receiving facilities must adhere to the conditions set out in their respective permits and authorisations.

Prior to the commencement of the development, a Construction Waste Manager will be appointed by the Contractor. The Construction Waste Manager will be in charge of the implementation of the objectives of the plan, ensuring that all hired waste contractors have the necessary authorisations and that the waste management hierarchy is adhered to. The person nominated must have sufficient authority so that they can ensure everyone working on the development adheres to the management plan.

The WMP will provide systems that will enable all arisings, movements and treatments of construction waste to be recorded. This system will enable the contractor to measure and record the quantity of waste being generated. It will highlight the areas from which most waste occurs and allows the measurement of arisings against performance targets. The WMP can then be adapted with changes that are seen through record keeping.

4.4 Access and Transportation

4.4.1 Site Entrance

It is proposed to access the site of the Proposed Development via an existing access track off the local road to the east of the site. This entrance will be widened to facilitate the delivery of the construction materials and turbine components. The site entrance was subject to Autotrack assessment to identify the turning area required, as described in Section 15.1 of the Traffic and Transport Assessment. Appropriate sightlines will be established to the north and south of the proposed site entrance for the safe egress of traffic. The proposed works will result in a permanent upgrade of this current site access from the local road, which will also form the entrance to the Proposed Development during the operational phase.

The location of the site entrance is shown on the site layout drawing in Figure 4-1. An Traffic Management Plan is included in the CEMP in Appendix 4.4 of this EIAR. In the event planning permission is granted for the Proposed Development, the final Traffic Management Plan will address the requirements of any relevant planning conditions, including any additional mitigation measures which are conditioned.

4.4.2 Turbine and Construction Materials Transport Route

It is proposed that large wind turbine components will be delivered to the site of the proposed development, from Dublin Port or Galway Port, via the N68 National Secondary Road. The proposed turbine transport route from the N68 National Secondary Road to the proposed development site is shown on Figure 4-21. From Ennis the turbines will be transported southwest along the N68 National Secondary Road before turning right on to the R484 Regional Road and transported northwest until

they reach the village of Kilmihil. The turbines will pass straight through Kilmihil continuing on the R484 until it reaches Creegh. At Creegh, the turbines will turn right at the crossroad onto a local road passing Creegh North, Clooneenagh and Cahermurphy Hill after which it will take a sharp left onto a local road approaching the proposed wind farm development site from the south.

The delivery route for general HGV construction traffic will follow a more direct route to the site via the local road network from the village of Kilmihil as shown on Figure 4-21. It is noted that this route was used for general construction traffic for the Cahermurphy Phase 1 Wind Farm development.

All deliveries of turbine components and other construction materials to the site will only be by way of the proposed transport routes outlined in Figure 4-21. No other public road route will be used as part of the construction phase of the proposed development for the transport of materials. The number of construction vehicles that will be generated during the construction phase of the proposed development are outlined as part of the traffic and transport assessment in Section 15.1 of this EIAR.

4.4.2.1 Accommodation Works

Works such as road widening are sometimes required along proposed turbine transport routes to accommodate the large vehicles used to transport turbine components to wind farm sites. The proposed transport route for the proposed development has been the subject of a route assessment to determine if any widening works are required along its length. Full details of the assessment are included as part of the traffic impact assessment set out in Section 15.1.8 of this EIAR and summarised below:

Location 1 – N68 / R484 junction at Ballyduneen

Vehicles will be accommodated with some minor temporary local widening of the carriageway and temporary relocation of some signs, street furniture and overhead cables.

Location 2 – Double bend at Sheeauh

There will requirement for some minor temporary carriageway widening at this location.

Location 3 – Right turn at graveyard

Minor temporary local widening of the road will be required to the south of this location in order to accommodate the extended wind turbine vehicles.

Location 4 – Bridge over River Creegh

There will be a requirement for minor temporary local widening at this location.

Location 5 – Right turn through Creegh

There will be minor temporary widening required southwest of the junction. It is also noted that some sign posts will need to be removed temporarily.

Location 6 – Bridge at Creegh North

The preliminary assessment indicated that minor temporary widening will be required at this location.

Location 7 – Double bend at Clooneenagh

Local minor carriageway widening will be required at this S-bend.

Map Legend

- EIAR Study Boundary
- Proposed Turbine Delivery Route
- Proposed Construction Traffic Route

MAP TITLE: **Proposed Turbine Delivery/Haul Route**		MAP NO.: **Figure 4.21**	SCALE: **1:35,000**
PROJECT TITLE: **Cahermurphy Two Wind Farm**			DATE: **13-07-2020**
DRAWING BY: **Eoin O'Sullivan**	CHECKED BY: **Michael Watson**		ISSUE NO.: **170238-2020.07.13-D3**

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Location 8 – Bend west of Cahermurphy Hill

There will be a requirement for minor temporary local road widening at this location.

Location 9 - Triangle near school

The preliminary assessment indicates that works are not required at this location.

Location 10 – Left turn up to site

Minor carriageway widening will be required to the south of the existing road in order to accommodate the wind turbine vehicles.

4.4.3 Traffic Management

A turbine with a blade length of 68.5 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 74.6 metres, including the blade which overhangs the back of the vehicle. The total length of the tower transporter is 46.7 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 of the Proposed Development will be smaller than the design test vehicles. The turbine delivery vehicles have been modelled accurately in the Autotrack assessments for the site access junctions, as detailed in Section 15.1 of this EIAR.

The need to transport turbine components 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. With over 350 No. wind farms already built and operating in Ireland (Republic and Northern Ireland combined, as per latest available figures on www.iwea.com), transport challenges are something the wind energy industry and specialist transport sector has become particularly adept in finding solutions to.

An Traffic Management Plan has been prepared as set out in the CEMP in Appendix 4.4 of the EIAR. In the event planning permission is granted for the Proposed Development, the final Traffic Management Plan will address the requirements of any relevant planning conditions, including any additional mitigation measures which are conditioned.

The plan will include:

- A delivery schedule.
- Details of works or any other minor alteration identified.
- A dry run of the route using vehicles with similar dimensions.

The deliveries of turbine components to the site may 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.

It is not anticipated that any section of the public 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 where required will be made outside the normal peak traffic periods, at night, to avoid disruption to work and school-related traffic.

Prior to the Traffic Management Plan being finalised, a full dry run of the transport operation along the proposed route will be completed using vehicles with attachments to simulate the dimensions of the wind turbine transportation vehicles. This dry run will inform the Traffic Management Plan submitted for agreement with Clare County Council. All turbine deliveries will be provided for in the Transport Management Plan which will be finalised in advance of the construction stage, when the exact transport arrangements are known, delivery dates confirmed and escort proposals in place. The finalised Transport Management Plan will be submitted to the Planning Authority for agreement in advance of any abnormal loads using the local roads, and will provide for all necessary safety measures, including a convoy and Garda escort as required, off-peak turning/reversing movements and any necessary safety controls.

4.5 Community Gain Proposal

Cahermurphy Two Wind Farm has the potential to bring significant positive benefit to the local community. The project will create sustainable local employment, it will contribute annual rates to the local authority and it will provide opportunity for local community investment in the project in line with the new Renewable Energy Support Scheme. A community benefit fund will be put in place for the lifetime of the project to provide direct funding to those areas surrounding the project.

4.5.1 Renewable Energy Support Scheme

The recent Renewable Energy Support Scheme (RESS) Terms and Conditions, published by the Department of Communications, Climate Action and Environment on the 27th February 2020, make some high level provisions for how this type of benefit fund will work. Any project which wants to export electricity to the national grid must abide by these broad principles. These include the following:

1. *a minimum of €1,000 shall be paid to each household located within a distance of a 1 kilometre radius from the Project;*
2. *a minimum of 40% of the funds shall be paid to not-for-profit community enterprises whose primary focus or aim is the promotion of initiatives towards the delivery of the UN Sustainable Development Goals, in particular Goals 4, 7, 11 and 13, including education, energy efficiency, sustainable energy and climate action initiatives;*
3. *a maximum of 10% of the funds may be spent on administration. This is to ensure successful outcomes and good governance of the Community Benefit Fund.*
4. *the balance of the funds shall be spent on initiatives successful in the annual application process, as proposed by clubs and societies and similar not-for-profit entities, and in respect of Onshore Wind RESS 1 Projects, on "near neighbour payments" for households located outside a distance of 1 kilometre from the Project but within a distance of 2 kilometres from such Project.*

4.5.2 Community Benefit Fund

MCRE expects that for each megawatt hour (MWh) of electricity produced by the wind farm, the project will contribute €2 into a community fund for the RESS period i.e. first 15 years of operation and €1 per MWh for the remaining lifetime of the wind farm. If this commitment is improved upon in upcoming Government Policy we will adjust accordingly.

If this project is constructed as currently designed we estimate that a total of approximately 5.6 million euro will be available in the local area for community funding over the lifetime of the project. The above figure is indicative only and will be dependent on the generation capacity of the wind farm which is influenced by a number of factors including:

1. *Number of wind turbines.*
2. *Capacity and availability of energy production of those turbines.*
3. *Quantity of wind*

4.6 Site Drainage

4.6.1 Introduction

The drainage design for the Proposed Development has been prepared by Hydro Environmental Services Ltd. (HES). 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. The Proposed Development's drainage design 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.

4.6.2 Existing Drainage Features

The routes of any natural drainage features will not be altered as part of the Proposed Development. Turbine locations have been selected to avoid natural watercourses. It is proposed that 4 no. new stream crossings and potentially 1 no. existing stream crossing upgrades will be required to facilitate the wind farm development.

There will be no direct discharges to natural watercourses. All discharges from the proposed works areas or from interceptor drains will be made over vegetated ground at an appropriate distance from natural watercourse and lakes. Buffer zones around the existing natural drainage features have informed the layout of the Proposed Development, and are indicated on the drainage design drawings.

Where artificial drains are currently in place in the vicinity of proposed works areas, these drains may have to be diverted around the proposed works areas to minimise the amount of water in the vicinity of works areas. Where it may not be possible to divert artificial drains around proposed work areas, the drains will be blocked to ensure sediment laden water from the works areas has no direct route to other watercourses. Where drains have to be blocked, the blocking will only take place after an alternative drainage system to handle the same water has been put in place.

Existing artificial drains in the vicinity of existing site roads will be maintained in their present location where possible. If it is expected that these artificial drains will receive drainage water from works areas, check dams will be added (as specified below) to control flows and sediment loads in these existing

artificial drains. If road widening or improvement works are necessary along the existing roads, where possible, the works will take place on the opposite side of the road to the drain.

4.6.3 Drainage Design Principles

Drainage water from any works areas of the site of the Proposed Development 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.

A schematic line drawing of the proposed drainage design is presented in Figure 4-22 below.

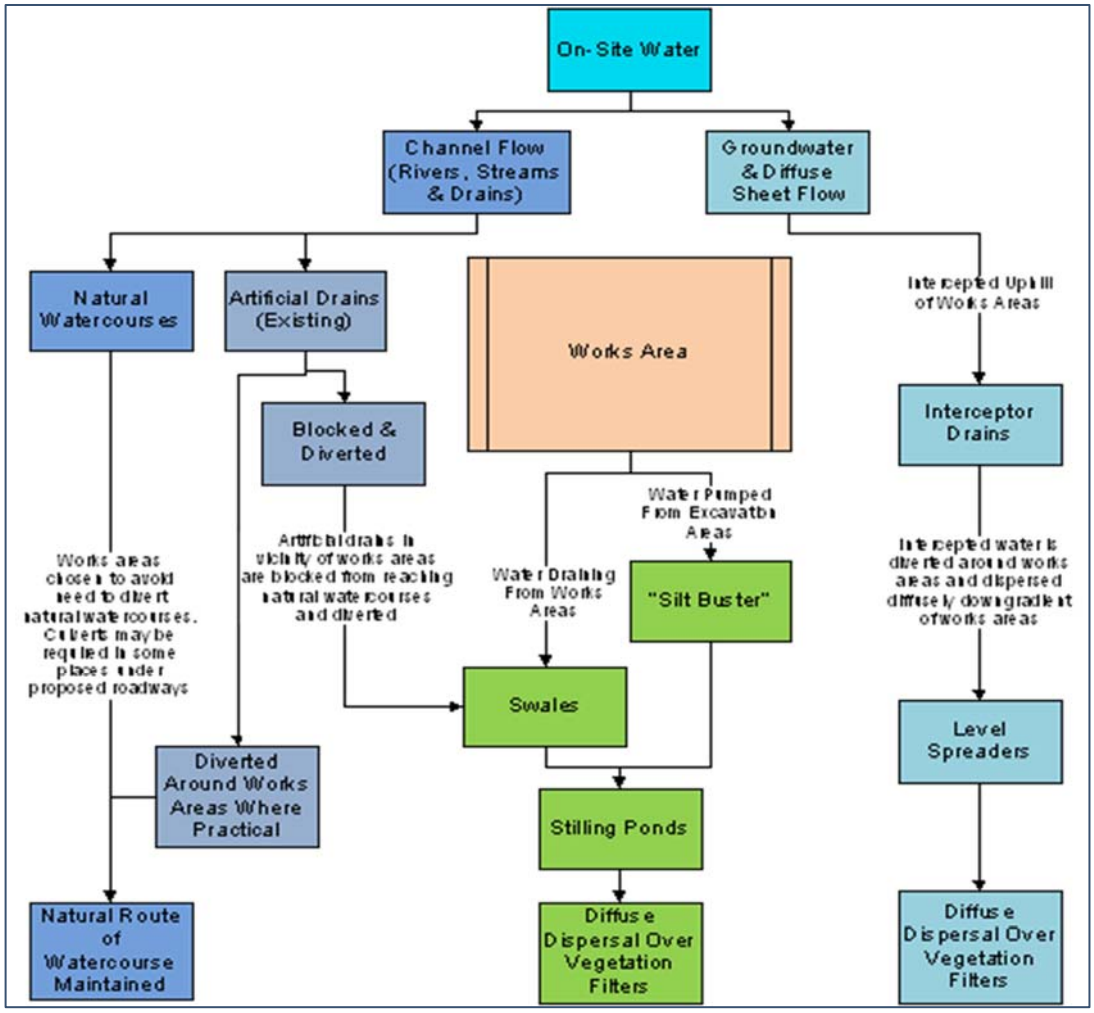


Figure 4-22 Proposed Wind Farm Drainage Process Flow

4.6.4 Drainage Design

A detailed drainage design for the Proposed Development, incorporating all principles and measures outlined in this drainage design description, has been prepared, and is included in Appendix 4-5 to this EIAR. The drainage design employs the various measures further described below and is cognisant of the follow guidance documents:

- Forestry Commission (2004): Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh;
- Coillte (2009): Forest Operations & Water Protection Guidelines;
- Forest Services (Draft) Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures;
- Forest Service (2000): Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford;
- COFORD (2004): Forest Road Manual – Guidelines for the Design, Construction and Management of Forest Roads;
- Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Watercourses;
- Good Practice During Wind Farm Construction (Scottish Natural Heritage, 2010);
- 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); and,
- CIRIA 2006: Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2006.

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 could 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. Figure 4-23 below shows an illustrative drawing of an interceptor drain.

The velocity of flow in the interceptor will be controlled by check dams (see Section 4.6.4.3 below), 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 4.7.5.4 below). 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 Swales

Drainage swales 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. Figure 4-23 shows an illustrative example of a drainage swale.

Drainage swales 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.

Drainage swales 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 drainage swales, 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.

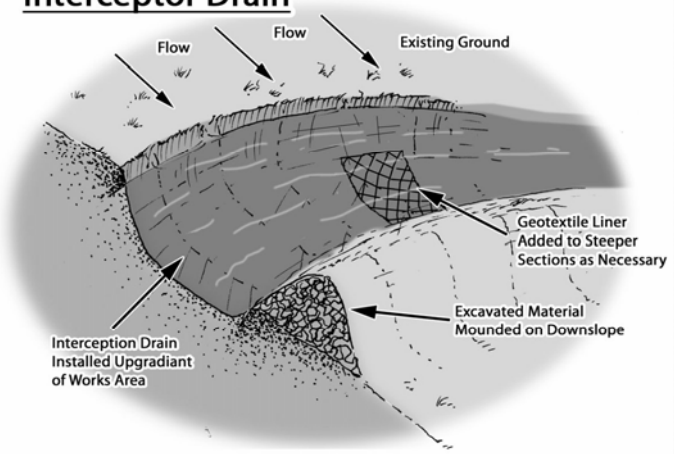
Check dams will restrict flow velocity, minimise channel erosion and promote sedimentation behind the dam. The check dams will be installed as the interceptor drains are being excavated. Check dams may also be installed in some of the existing artificial drainage channels on the site, downstream of where 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 4-6 inch stone will be built up on either side and over the straw bale to a maximum height of 600mm 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. Figure 4-23, above, shows illustrative examples of check dams.

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 150mm 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.

Drainage Design Measures

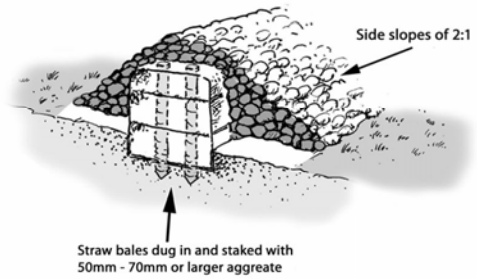
Interceptor Drain



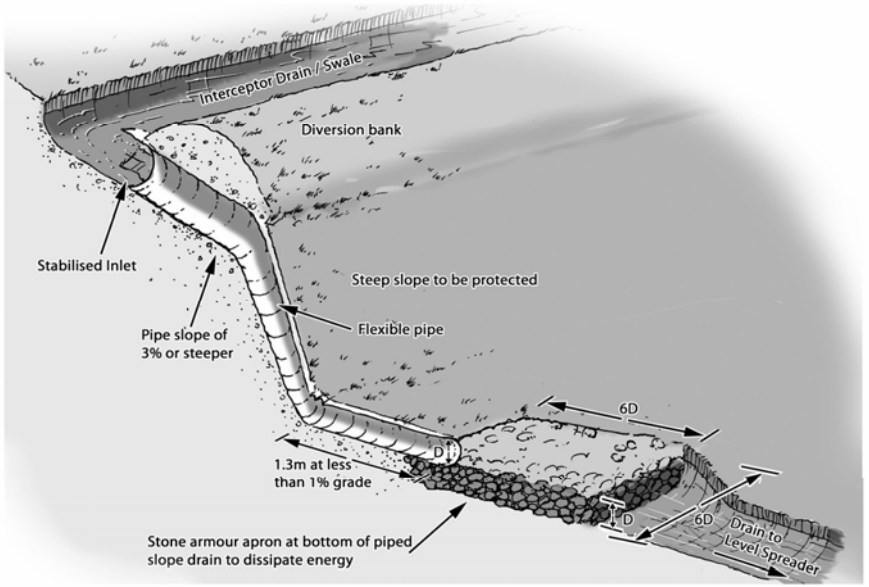
Check Dam (Stone Dam in Drain)

Check Dam

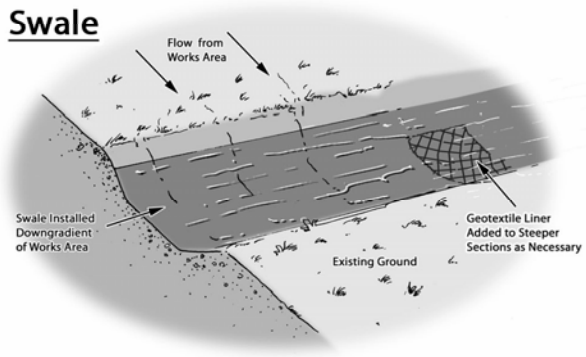
(Straw Bale & Stone Dam - Cross Section)



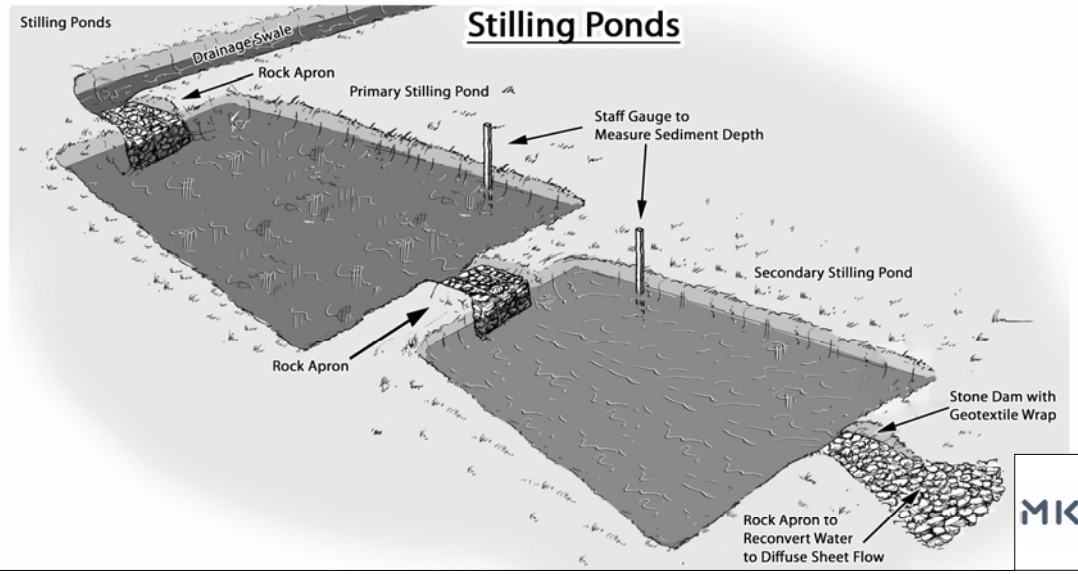
Slope Pipe Drain



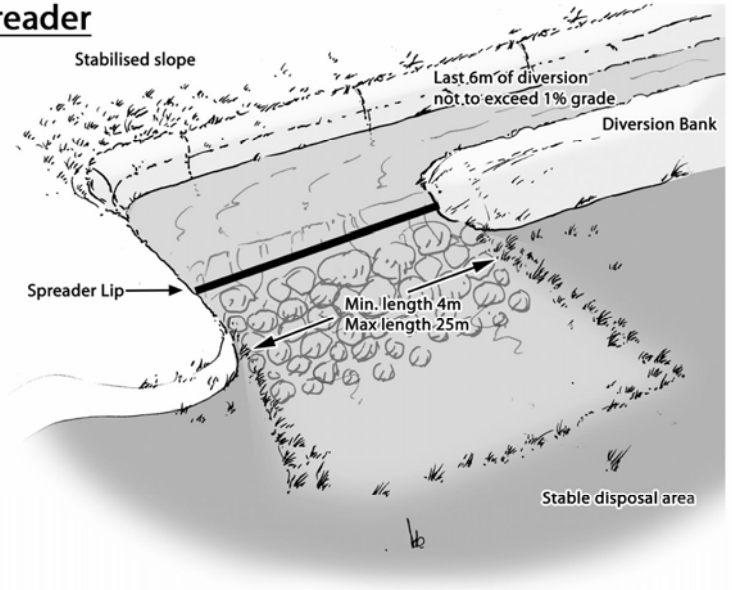
Swale



Stilling Ponds



Level Spreader



MAP TITLE: **Drainage Design Measure Illustrations**		MAP NO.: **Figure 4-23**	SCALE: **NTS**
PROJECT TITLE: **Cahermurphy Two Wind Farm**			DATE: **17-12-2019**
DRAWING BY: **Eoin O'Sullivan**	CHECKED BY: **Michael Watson**	ISSUE NO.: **170238- 2019.12.17 - D1**	

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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 Spreader

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.

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. Figure 4-23, above, shows an illustrative example of a level spreader.

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 (see Section 4.6.4.5 below) 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 Piped Slope Drains

Piped slope drains will be used to convey surface runoff from diversion drains safely down slopes to flat areas without causing erosion. Once the runoff reaches the flat areas it will be reconverted to diffuse sheet flow. Level spreaders will only be established on slopes of less than 6% in grade. Piped slope drains will be used to transfer water away from areas where slopes are too steep to use level spreaders.

The piped slope drains will be semi-rigid corrugated pipes with a stabilised entrance and a rock apron at the outlet to trap sediment and dissipate the energy of the water. The base of drains leading into the top of the piped slope drain will be compacted and concavely formed to channel the water into the corrugated pipe. The entrance at the top of the pipe will be stabilised with sandbags if necessary. The pipe will be anchored in place by staking at approximately 3-4 metre intervals or by weighing down

with compacted soil. The bottom of the pipe will be placed on a slope with a grade of less than 1% for a length of 1.5 metres, before outflowing onto a rock apron.

The rock apron at the outlet will consist of 6-inch stone to a depth equal to the diameter of the pipe, a length six times the diameter of the pipe. The width of the rock apron will be three times the diameter of the pipe where the pipe opens onto the apron and will fan out to six times the diameter of the pipe over its length. Figure 4-23, above, shows a diagrammatic example of a piped slope drain and rock apron.

Piped slope drains will only remain in place for the duration of the construction phase of the Proposed Development. On completion of the works, the pipes and rock aprons will be removed and all channels backfilled with the material that was originally excavated from them.

Piped slope drains will be inspected weekly and following rainfall events. Inlet and outlets will be checked for sediment accumulation and blockages. Stake anchors or fill over the pipe will be checked for settlement, cracking and stability. Any seepage holes where pipe emerges from drain at the top of the pipe will be repaired promptly.

4.6.4.6 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 ponds prior to diffuse discharge to the vegetation filters via a level spreader.

4.6.4.7 Stilling Ponds

Stilling ponds will be used to attenuate runoff from works areas of the site of the Proposed Development during the construction phase, and will remain in place to handle 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. Figure 4-23, above, shows an illustrative example of a stilling pond system.

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.

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 to 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 when 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.

4.6.4.8 Siltbuster

A “siltbuster” or similar equivalent piece of equipment will be available to filter any water pumped out of excavation areas if necessary, prior to its discharge to stilling ponds or swales.

Siltbusters are mobile silt traps that can remove fine particles from water using a proven technology and hydraulic design in a rugged unit. The mobile units are specifically designed for use on construction sites.

The unit stills the incoming water/solids mix and routes it upwards between a set of inclined plates for separation. Fine particles settle onto the plates and slide down to the base for collection, whilst treated water flows to an outlet weir after passing below a scum board to retain any floating material. The inclined plates dramatically increase the effective settling area of the unit giving it a very small footprint on site and making it highly mobile. Figure 4-24 below shows an illustrative diagram of the Siltbuster.

The Siltbuster units are now considered best practice for the management of dirty water pumped from construction sites. The UK Environment Agency and the Scottish Environmental Protection Agency have all recommended/specified the use of Siltbuster units on construction projects.

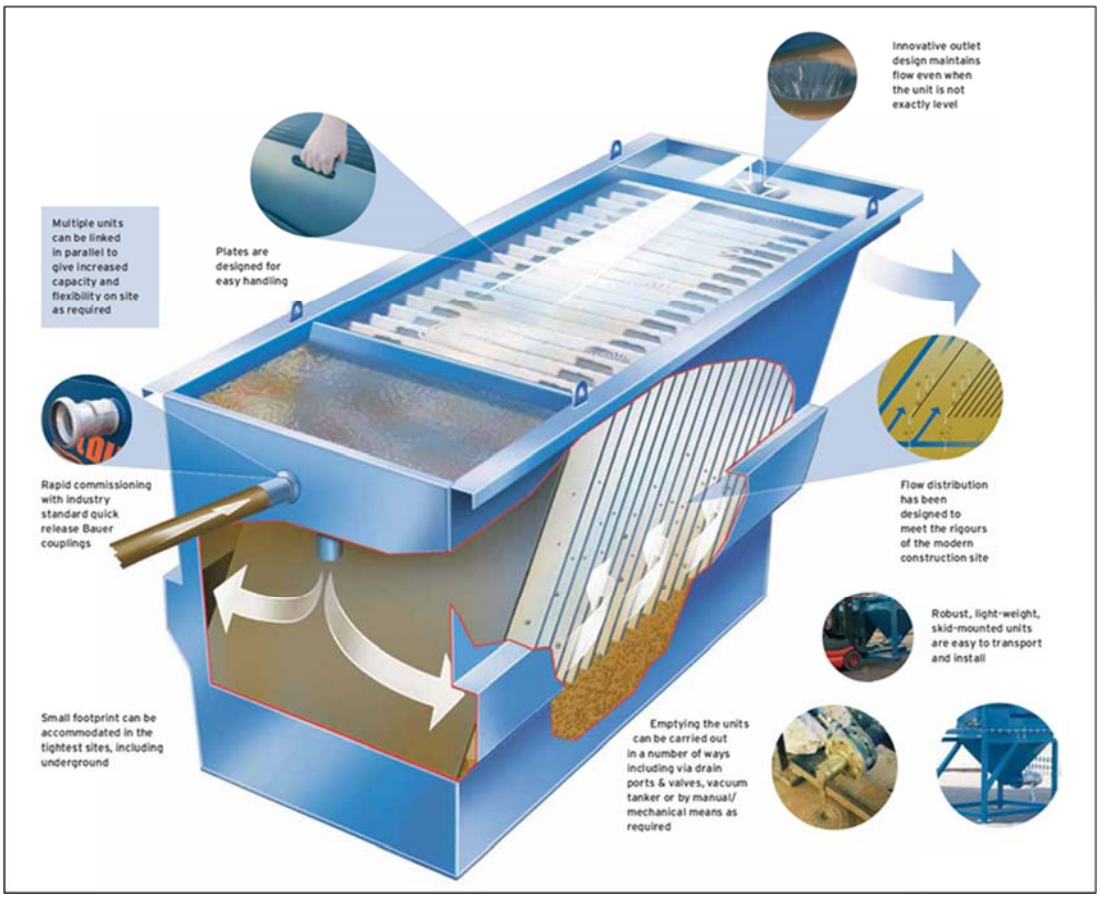


Figure 4-24 Siltbuster (Source: https://www.siltbuster.co.uk/sb_prod/siltbuster-fb50-settlement-unit/)

4.6.4.9 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 4-5 and Plate 4-6 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 4-5 Silt Bag with water being pumped through

Plate 4-6 Silt bag under inspection

4.6.4.10 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.

4.6.4.11 Culverts

All new proposed culverts and proposed culvert upgrades will be suitably sized for the expected peak flows in the watercourse.

Some culverts may be installed to manage drainage waters from works areas of the proposed development, particularly where the waters have to be taken from one side of an existing roadway to the other for discharge. The size of culverts will be influenced by the depth of the track or road sub-base. In all cases, culverts will be oversized to allow mammals to pass through the culvert.

Culverts will be installed with a minimum internal gradient of 1% (1 in 100). Smaller culverts will have a smooth internal surface. Larger culverts may have corrugated surfaces which will trap silt and contribute to the stream ecosystem. 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.

4.6.4.12 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 or 100m buffer zone of a lake, which is inevitable where existing roads in proximity to watercourses are to be upgraded as part of the proposed development. These areas include around existing culverts, around the headwaters of watercourses, and the proposed locations are indicated on the detailed drainage design drawings included in Appendix 4-5.

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 Construction Industry Research and Information Association (Ciria, No. C648, 1996). Up to three silt fences may be deployed in series.

All silt fencing will be formed using Terrastop Premium or equivalent silt fence product.

Site fences will be inspected regularly to ensure water is continuing to flow through the fabric, and the fence is not coming under strain from water backing up behind it.

4.6.5 Forestry Felling Drainage Measures

Tree felling to facilitate the Proposed Development will not be undertaken simultaneously with construction groundworks. Keyhole felling to facilitate construction works will take place prior to groundworks commencing. Some further felling may take place after all groundworks have been completed but while turbines are being commissioned.

Before the commencement of any felling works, an Environmental Clerk of Works (ECoW) shall be appointed to oversee the keyhole and extraction works. The ECoW shall be experienced and competent, and shall have the following functions and operate their record using a Schedule of Works Operation Record (SOWOR), as proposed in the planning application:

- Attend the site for the setup period when drainage protection works are being installed, and be present on site during the remainder of the forestry keyhole felling works.
- Prior to the commencement of works, review and agree the positioning by the Operator of the required Aquatic Buffer Zones (ABZs), silt traps, silt fencing (see below), water crossings and onsite storage facilities for fuel, oil and chemicals (see further below).
- Be responsible for preparing and delivering the Environmental Tool Box Talk (TBT) to all relevant parties involved in site operations, prior to the commencement of the works.
- Conduct daily and weekly inspections of all water protection measures and visually assess their integrity and effectiveness in accordance with Section 3.4 (Monitoring and Recording) and Appendix 3 (Site Monitoring Form (Visual Inspections)) of the *Forestry & Freshwater Pearl Mussel Requirements.*
- Take representative photographs showing the progress of operation onsite, and the integrity and effectiveness of the water protection measures.
- Collect water samples for analysis by a 3rd party accredited laboratory, adhering to the following requirements:
    - Surface water samples shall be collected upstream and downstream of the keyhole felling site at suitable sampling locations.
    - Sampling shall be taken from the stream / river bank, with no in-stream access permitted.
    - The following minimum analytical suite shall be used: pH, Electrical Conductivity, Total Suspended Solids, Biochemical Oxygen Demand, Total Phosphorus, Ortho-Phosphate, Total Nitrogen, and Ammonia.
- Review of operator's records for plant inspections, evidence of contamination and leaks, and drainage checks made after extreme weather conditions.
- Prepare and maintain a contingency plan.
- Suspend work where potential risk to water from siltation and pollution is identified, or where operational methods and mitigation measures are not specified or agreed.
- Prepare and maintain a Water Protection Measure Register. This document is to be updated weekly by the ECoW.

All relevant measures set out in the *Forestry & Freshwater Pearl Mussel Requirements, Forestry & Water Quality Guidelines, Forest Harvesting & the Environment Guidelines and the Forest Protection Guidelines* will apply. To protect watercourses, the following measures will be adhered to during all keyhole/tree felling activities.

- Works will be overseen by an ECoW as described above.
- The extent of all necessary tree felling will be identified and demarcated with markings on the ground in advance of any felling commencing.
- All roads and culverts will be inspected prior to any machinery being brought on site to commence the felling operation. No tracking of vehicles through watercourses will occur. Vehicles will only use existing road infrastructure and established watercourse crossings.
- Existing drains that drain an area to be felled towards surface watercourses will be blocked, and temporary silt traps (which may include a combination of the drainage components outlined in Section 4.6.3) will be constructed to ensure collection of all silt within felling areas. These temporary silt traps will be cleaned out and backfilled once felling works are complete. This ensures there is no residual collected silt remaining in blocked drains after felling works are completed. No direct discharge of such drains to watercourses will occur from within felling areas.
- New collector drains and sediment traps will be installed during ground preparation to intercept water upgradient of felling areas and divert it away. Collector drains will be excavated at an acute angle to the contour (0.3%-3% gradient), to minimise flow velocities.
- All silt traps will be sited outside of buffer zones and have no direct outflow into the aquatic zone. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of away from all aquatic zones.
- All new collector drains will taper out before entering the aquatic buffer zone to ensure the discharging water gently fans out over the buffer zone before entering the aquatic zone.
- Machine combinations, such as mechanical harvesters or chainsaw felling,will be chosen which are most suitable for ground conditions at the time of felling, and which will minimise soils disturbance;
- Mechanised operations will be suspended during and immediately after heavy rainfall.
- Where brash is required to form brash mats, it is to be laid out at harvesting stage to prevent soil disturbance by machine movement.
- Brash which has not been pushed into the soil may be moved within the site to facilitate the creation of mats in more demanding locations.
- Felling of trees will be pointed directionally away from watercourses.
- Felling will be planned to minimise the number of machine passes in any one area.
- Extraction routes, and hence brash mats, will be aligned parallel to the ground contours where possible.
- Harvested timber will be stacked in dry areas, and outside any 50-metre watercourse buffer zone. Straw bales and check dams to be emplaced on the down gradient side of timber storage sites.
- Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed, but removing of natural debris deflectors will be avoided.

4.6.6 Borrow Pit Drainage

While surface water will be contained in the borrow pits areas, the design proposal is to control the level of water in the borrow pit area by creating a single point outlet from the basin-like area that will ensure the water does not overtop the pit area. Run-off from the proposed borrow pit areas will be controlled via a single outlet that will be installed at the edge of the borrow pit. The single outfall point will be constructed to control runoff from the borrow pit and its immediate surrounds. Interceptor drains will already have been installed upgradient of the borrow pit area before any extraction begins.

During the construction phase of the project, it will be necessary to keep the borrow pit area free of standing water while rock is still being extracted. This will be achieved by using a mobile pump, which

will pump water into the same series of drains, settlement ponds and level spreader, which will receive the water from the single outlet.

4.6.7 Cable Trench Drainage

Cable trenches are typically developed in short 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.

To efficiently control drainage runoff from cable trench works areas, excavated material is stored on the upgradient side of the trench. Should any rainfall cause runoff from the excavated material, the material is 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 pits or used for landscaping and reinstatements of other areas elsewhere on site.

On steeper slopes, silt fences, as detailed in Section 4.6.4.12, above, will be installed temporarily downgradient of the cable trench works area, or on the downhill slope below where excavated material is being temporarily stored to control run-off.

4.6.8 Site and Drainage Management

4.6.8.1 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 adequate 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.

4.6.8.2 Pre-emptive Site Drainage Management

The works programme for the groundworks part of the construction phase of the Proposed Development 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.

4.6.8.3 Reactive Site Drainage Management

The final drainage design prepared for the Proposed Development prior to commencement of construction will 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 ECoW or supervising hydrologist on-site. The ECoW 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. 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 the situation on the ground at a particular time.

In the event that works are giving rise to siltation of watercourses, the ECoW 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.

4.6.9 Drainage Maintenance

An inspection and maintenance plan for the drainage system onsite will be prepared in advance of commencement of any works on the Proposed Development. 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 ECoW or the supervising hydrologist.

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 ensure 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 Proposed Development 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 be 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 to a number of silt traps 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 Proposed Development 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 Proposed Development. Weekly inspections during the construction phase will be reduced to monthly, bi-monthly and eventually quarterly inspections during the operational phase up until the site has revegetated and the natural silt controls regenerate. 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 Phasing and Timing

It is estimated that the construction phase of the Proposed Development will take approximately 12-18 months from starting on site to the commissioning of the electrical system. In the interest of breeding birds, construction will not commence during the Breeding Bird season from April to July inclusive. Construction may commence at any stage from August onwards to the end of 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.

4.7.1 Construction Sequencing

The construction phase can be broken down into three main phases, 1) civil engineering works - 10 months, 2) electrical works - 6 months, and 3) turbine erection and commissioning - 8 months. The main task items under each of the three phases are outlined below.

Civil Engineering Works

- Clear and hardcore area for temporary site offices. Install same.
- Construct bunded area for oil tanks.
- Clear and construct new site roads and hard-standings and crane pads.
- Construct drainage ditches, culverts etc. integral to road construction.
- Excavate for turbine bases. 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.
- Install meteorological mast.

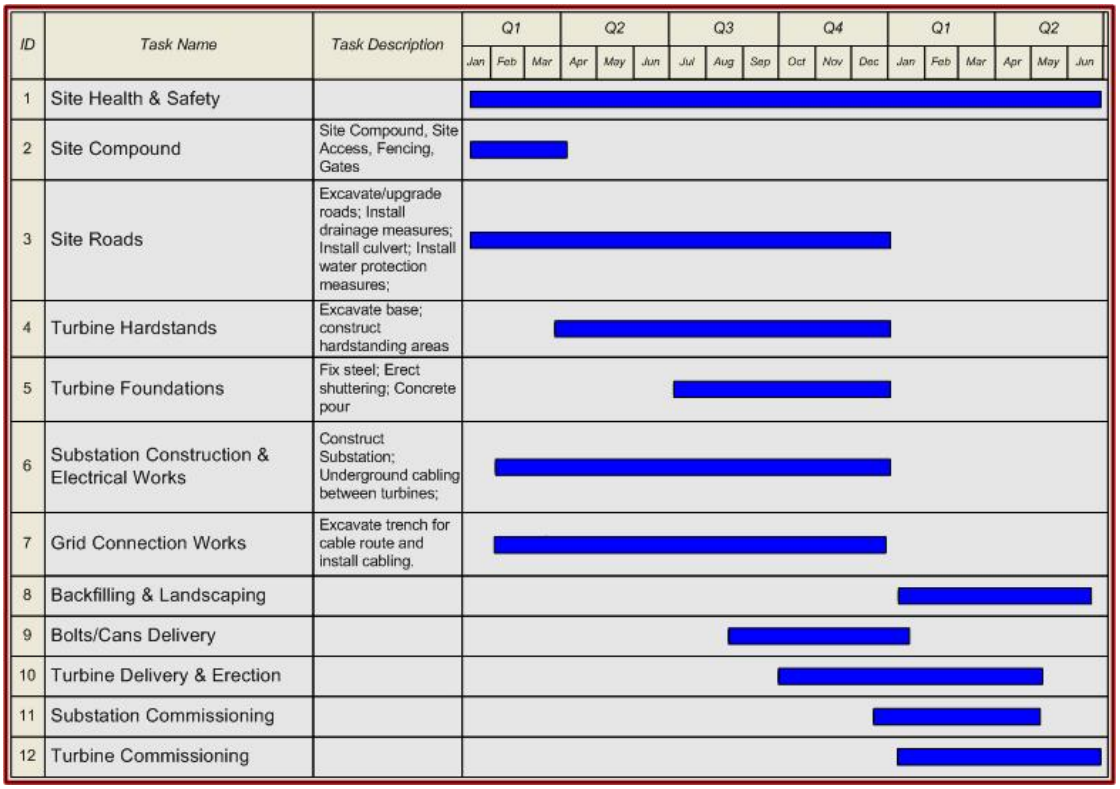
Electrical Works

- Construct bases/plinths for substation building.
- 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 previously stored topsoil.
- Erect towers, nacelles and blades.
- Complete electrical installation.
- Install anemometry 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 4-25 below, where 1st January has been selected as an arbitrary start date for construction activities.



ID	Task Name	Task Description
1	Site Health & Safety	
2	Site Compound	Site Compound, Site Access, Fencing, Gates
3	Site Roads	Excavate/upgrade roads; Install drainage measures; Install culvert; Install water protection measures;
4	Turbine Hardstands	Excavate base; construct hardstanding areas
5	Turbine Foundations	Fix steel; Erect shuttering; Concrete pour
6	Substation Construction & Electrical Works	Construct Substation; Underground cabling between turbines;
7	Grid Connection Works	Excavate trench for cable route and install cabling.
8	Backfilling & Landscaping	
9	Bolts/Cans Delivery	
10	Turbine Delivery & Erection	
11	Substation Commissioning	
12	Turbine Commissioning	

Figure 4-25 Indicative Construction Schedule

4.7.2 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 wind farm site and submitted for agreement to the Planning Authority is now well-established.

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 and all conditions attached to the grant of planning permission and allows them to be audited on a systematic and regular basis. The first assessment is a simple 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.

A Construction Environmental Management Plan (CEMP) has been prepared for the Proposed Development, and is included in Appendix 4.4 of this EIAR. The CEMP includes details of drainage, peat and overburden management, waste management etc, and describes how the above-mentioned Audit Report will function and be presented. In the event planning permission is granted for the Proposed Development, the CEMP will be updated prior to the commencement of the development, to address the requirements of any relevant planning conditions, including any additional mitigation measures which are conditioned and will be submitted to the Planning Authority for written approval.

The on-site construction staff will be responsible for implementing the mitigation measures specified in the EIAR and compiled in the Audit Report. Their implementation will be overseen by the ECoW 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

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 removed to the onsite borrow pit. 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 sealed using the back of the excavator bucket to ensure no water is trapped within the material and it 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 be raised with clause 804 or similar hardcore material, compacted in 250 millimetres (mm) layers, with sufficient compacted effort (i.e. compacted with 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.

In the case where a piled foundation is required; the piles will most likely be constructed by coring and inserting a steel sleeve which will be filled with reinforced concrete prior to sleeve removal.

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 360º 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 360º excavator or crane 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 filled with suitable fill up to existing ground level. The working area around the perimeter of the foundation will be backfilled with the original material that was excavated.

4.8.2 Site Roads and Crane Pad Areas

Site roads will be constructed to each turbine base and at each base a crane hard standing will be constructed to the turbine manufacturer's specifications and the largest predicted area has been assessed in this EIAR. Tracked excavators will carry out excavation for roads with appropriate equipment attached. The excavations shall follow a logical route working away from the borrow pit locations. Excavated material will be transported back to the borrow pits in haul trucks. A two to three metre wide working area will be required around each hard standing area, 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 sealed using the back of the excavator bucket and surrounded by silt fences to ensure sediment-laden run-off does not occur. The excavated material will be located on level ground and outside a 50 metre watercourse buffer.

When the formation layer has been reached, stone from the on-site borrow pit shall be placed to form the road foundation. In the event of large clay deposits being encountered in sections of road, a geotextile layer will be required at sub base level. The sub grade will be compacted with the use of a roller. The final wearing course will not be provided until all bases have been poured. This prevents damage to the wearing course due to stone and concrete trucks movements. The road will be upgraded prior to the arrival of the first turbine. All roads will be maintained for the duration of the operation of the Proposed Development.

4.8.3 Onsite Electricity Substation and Control Building

The proposed electricity 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. Any excess material will be sent to one of the on-site proposed borrow pit, for reinstatement purposes.
- The dimensions of the onsite substation area have been designed to meet the requirements of the ESB or Eirgrid and the necessary equipment to safely and efficiently operate the permitted wind farms;
- One control building 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 damp proof course 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 & 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 have been designed to ESB/Eirgrid specifications.

4.8.4 Temporary Construction Compound

The temporary construction compound 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.

4.8.5 Grid Connection Cable Trench from sub-station to the National Grid

The underground cable required to facilitate the grid connection from the proposed onsite sub-station to the National Grid will be laid beneath the surface of the site and/or public road using the following typical methodology:

- The area where excavations are planned will be surveyed, prior to the commencement of works to confirm the conditions predicted in this EIAR, with a cable-avoiding tool and all existing underground services will be confirmed.
- Two teams consisting of two tracked excavators, two dumpers and a tractor and stone cart with side-shoot will dig the trench for and lay approximately 300m of the underground cable ducting per day.
- Both teams will start approximately 150m apart with the team behind finishing at the starting point of the team ahead.
- The excavators will open a trench at the edge of the road surface, the trench will be a maximum of approximately 600mm wide and 1,250mm deep.
- Clay plugs will be installed at 50m intervals to prevent the trench becoming a conduit for surface water runoff.
- Cable joint pits will be located at approximately 500m intervals or as otherwise required by ESB requirements along the proposed cable route, each joint pit will be approximately 2.6m x 8m in size and contain a communications chamber, an earth link box and a cable joint bay, all of which will be located in the road edge and accessible for cable pulling and future maintenance.
- Excavated material will be temporarily stockpiled onsite for re-use during reinstatement. Stockpiles will be restricted to less than 2m in height. Stockpiles will be located a minimum of 50m from surface water features and all stockpiling locations will be subject to approval by the Site Manager and Project Ecological Clerk of Works (ECoW).
- Once the trench has been excavated, a base layer of blinding will be installed by the tractor and cart and compacted by the excavators.

- The ducting along with marker strips will then be placed in the trench as per relevant specifications.
- Blinding will be installed to approximately 75mm above the cable ducting and compacted.
- The remainder of the trench will be backfilled with granular material and compacted.
- The trench will be surfaced as per the road surface specifications of the local public road.
- An unbound surface layer shall be placed over the grid connection route where it transverses forestry and agricultural land, as per ESB design requirements, in order to provide a road profile and graded to accommodate maintenance vehicles.

The transformer in each 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 cables are bedded with suitable material unless the ground conditions are such that no bedding is required. The cables will be laid at a depth that meets all national and international requirements, and will generally be approximately 1.3m below ground level; a suitable marking tape is installed between the cables and the surface (see Plate 4-7 below). On completion, the ground will be reinstated as previously described above. The route of the cable ducts will follow the access track to each turbine location, and are visible on the site layout drawings included as Appendix 4.1 of the EIAR.

The proposed on-site substation will be connected to the existing Booltiagh substation via underground grid connection cabling which will be constructed to ESB/Eirgrid specifications, using a similar methodology to that outlined above.

Plate 4-7 Typical Cable Trench View

4.8.5.1 Existing Underground Services

Any underground services encountered along the cable routes will be surveyed for level and the ducting will pass over the service provided adequate cover is available. A minimum clearance of 300 mm will be required between the bottom of the ducts and the service in question. If the clearance cannot be achieved the ducting will pass under the service and again 300 mm clearance between the top of the communications duct and bottom of the service will be achieved. In deeper excavations an additional layer of marker tape will be installed between the communications duct and top level yellow marker tape. If the required separation distances cannot be achieved then a number of alternative

options are available such as using steel plates laid across the width of the trench and using 35N concrete surrounding the ESB ducts where adjacent services are within 600mm, with marker tape on the side of the trench. Back fill around any utility services will be with dead sand/pea shingle where appropriate.

4.8.5.2 Joint Bays

Joint bays are pre-cast concrete chambers where lengths of cable will be joined to form one continuous cable. They will be located at various points along the ducting route generally between 600 to 1000 metres intervals or as otherwise required by ESB requirements.

Where possible, joint bays will be located in areas where there is a natural widening/wide grass margin on the road in order to accommodate easier construction, cable installation and create less traffic congestion. During construction the joint bay locations will be completely fenced off once they have been constructed they will be backfilled until cables are being installed.

4.8.5.3 Grid Connection Watercourse/Culvert Crossings

A total of 9 no. watercourse crossings have been identified along the proposed underground grid connection route, the locations of which are shown in Figure 4-26. The preferred methodologies for the provision of the grid connection at these locations is set out in Table 4-4 below, which provides a summary of the watercourse crossing/culvert survey and description of works for all crossings. Options 1,2, 3 and 4 have been assessed in this planning application. It should be noted that no option proposes in-stream works and all options are equal in terms of potential impacts across all environmental topics. A description of each crossing option is provided below. The construction methodology has been designed to eliminate the requirement for in-stream works.

4.8.5.3.1 *Standard Trefoil Formation over Piped Culvert Crossings – Option 1*

Watercourses will not be directly impacted upon since no instream works or bridge/culvert alterations are proposed. Where sufficient cover exists above the culvert, the trench will be excavated above the culvert and the ducts will be installed in the standard trefoil arrangement passing over the sealed pipe where no contact will be made with the watercourse.

Where no crossing currently exists, the cable will pass over the watercourse in a bottomless box culvert or pre-cast concrete slab in a standard trefoil arrangement.

Ths method of duct installation is further detailed in Figure 4-27.

4.8.5.3.2 *Standard Trefoil Formation under Piped Culvert Crossings – Option 2*

Where the culvert consists of a socketed concrete or sealed plastic pipe where sufficient cover over the culvert does not exist to accommodate the cable trench, a trench will then be excavated beneath the culvert and cable ducts will be installed in the trefoil arrangement under the sealed pipe.

If these duct installation methods cannot be achieved or utilised, the ducts will be installed by alternative means as set out in the following sections. This method of duct installation is further detailed in Figure 4-28.

4.8.5.3.3 *Flatbed Formation over Bridges/Culverts – Option 3*

Where cable ducts are to be installed over an existing culvert/bridge where sufficient cover cannot be achieved by installing the ducts in a trefoil arrangement, the ducts will be laid in a much shallower trench the depth of which will be determined by the location of the top of the culvert or the depth that can be achieved in the deck of a bridge structure. The ducts will be laid in this trench in a flatbed

formation over the existing culvert/bridge and will be encased in 6mm thick steel galvanized plate with a 35N concrete surround as per ESB Networks specification.

After the crossing over the culvert has been achieved, the ducts will resume to the trefoil arrangement within a standard trench. This method of duct installation is further detailed in Figure 4-29.

Where a bridge or culvert has insufficient deck cover to fully accommodate the required ducts, the ducts can be laid in a flatbed formation partially within the existing road make up. Where this option is to be employed, the ducts will also be encased in steel with a concrete surround as per Eirgrid and/or ESB Networks specifications. In order to achieve cover over these ducts and restore the carriageway of the road, it may be necessary to locally raise the pavement level to fully cover the ducts. The increased road level will be achieved by overlaying the existing pavement with a new wearing course as required. Any addition of a new pavement will be tied back into the existing road pavement at grade. After the crossing over the culvert has been achieved, the ducts will resume to the trefoil arrangement within a standard trench. This method of duct installation is further detailed in Figure 4-29.

The flatbed formation methodology will also be used at bridge structures where there is an existing footpath. The cables will be installed in the same flatbed arrangement where the existing footpath will be excavated to allow for the installation of the cables. The footpath will be reinstated after cable ducts have been installed. Where there is no existing footpath, it is proposed to install a footpath to encase the cable ducts after they have been laid in the flatbed formation.

4.8.5.3.4 *Directional Drilling – Option 4*

In the event that none of the above methods are appropriate, directional drilling will be utilised.

DD is a method of drilling under obstacles such as bridges, culverts, railways, water courses, etc. in order to install cable ducts under the obstacle. This method is employed where installing the ducts using standard installation methods is not possible.

The DD method of duct installation will be carried out using Vermeer D36 x 50 Directional Drill (approximately 22 tonnes), or similar plant, will be utilised for the horizontal directional drilling at watercourse/culvert crossings listed in Table 4-4 above. The launch and reception pits will be approximately 0.55m wide, 2.5m long and 1.5m deep. The pits will be excavated with a suitably sized excavator. The drilling rig will be securely anchored to the ground by means of anchor pins which will be attached to the front of the machine. The drill head will then be secured to the first drill rod and the operator shall commence to drill into the launch pit to a suitable angle which will enable him to obtain the depths and pitch required to the line and level of the required profile. Drilling of the pilot bore shall continue with the addition of 3.0m long drill rods, mechanically loaded and connected into position.

During the drilling process, a mixture of a natural, inert and fully biodegradable drilling fluid such as Clear Bore™ and water is pumped through the centre of the drill rods to the reamer head and is forced in to void and enables the annulus which has been created to support the surrounding subsoil and thus prevent collapse of the reamed length. Depending on the prevalent ground conditions, it may be necessary to repeat the drilling process by incrementally increasing the size of the reamers. When the reamer enters the launch pit, it is removed from the drill rods which are then passed back up the bore to the reception pit and the next size reamer is attached to the drill rods and the process is repeated until the required bore with the allowable tolerance is achieved.

The use of a natural, inert and biodegradable drilling fluid such as Clear Bore™ is intended to negate any adverse impacts arising from the use of other, traditional polymer-based drilling fluids and will be used sparingly as part of the drilling operations. It will be appropriately stored prior to use and deployed in the required amounts to avoid surplus. Should any excess drilling fluid accumulate in the reception or drilling pits, it will be contained and removed from the site in the same manner as other subsoil materials associated with the drilling process to a licensed recovery facility.

Map Legend

- EIAR Study Boundary
- Watercourse Crossing
- Proposed Cable Route
- Alternative Cable Route Option
- Existing Booltiagh 110kV Substation
- Proposed onsite Substation Locations

Cloonlaheen West
Magherantaska
Tullaghaboy
Holy Well
Megalithic Tomb
Creevagh
Doo Lough
Loch Dúlocha
Creevagh Lough
Carncreagh
Treanmanagh
Doolough Br
Sch
Carrownagry
Cragbeg Br
Illaunfreega Br
Cillín
Drummin Br
Boleybeg Lough
Doolough
Drummin
Lough Nacrag
Cragnashingaun
Sorrel Island Br
Glenmore
Illaunatoo or Sorrelisland
Gortaheera
Cahermurphy
Caheraghacullin
Cahermurphy Hill
Boolynamweel
Knockbrack
Cloonwhite North
Clooneenagh Cross
Graveyard
Castlepark
Holy Well
Cairn
Kiltumper
Mound
Ford
Cloonwhite South
Cahermurphy Lough
Cloniguil

MAP TITLE: **Watercourse Crossings**		MAP NO.: **Figure 4.26**	SCALE: **1:25,000**
PROJECT TITLE: **Cahermurphy Two Wind Farm**			DATE: **13-07-2020**
DRAWING BY: **Eoin O'Sullivan**	CHECKED BY: **Michael Watson**		ISSUE NO.: **170238-2020.07.13-D6**

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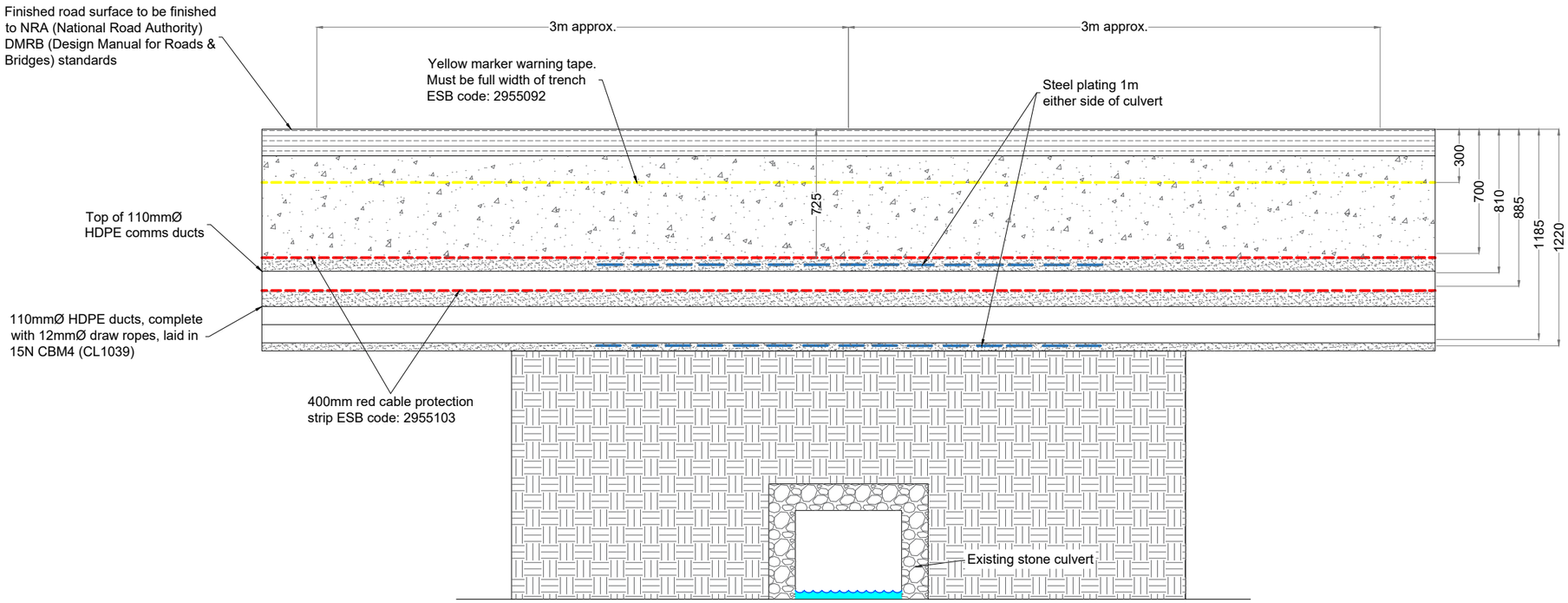
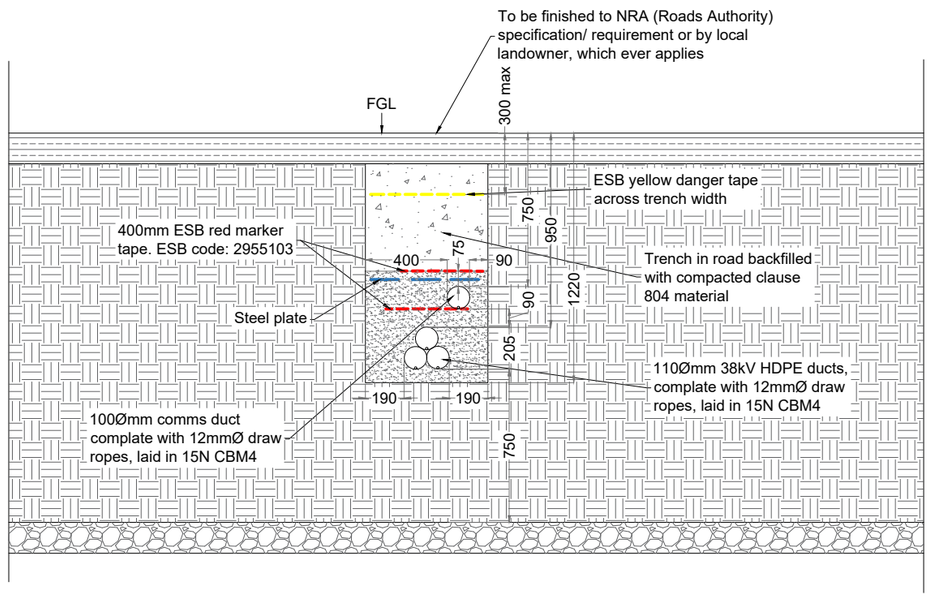


Longitudal section at watercourse crossing



Cross section at watercourse crossing

DRAWING TITLE:
Typical Cable Trench Over Culvert - Option 1

PROJECT TITLE:
Cahermurphy Wind Farm Two, Co. Clare

DRAWING BY:	CHECKED BY:
Joseph O Brien	Michael Watson
PROJECT No.: 170238	DRAWING No.: Fig 4-27
SCALE: 1:30 @ A3	DATE: 02.09.2020

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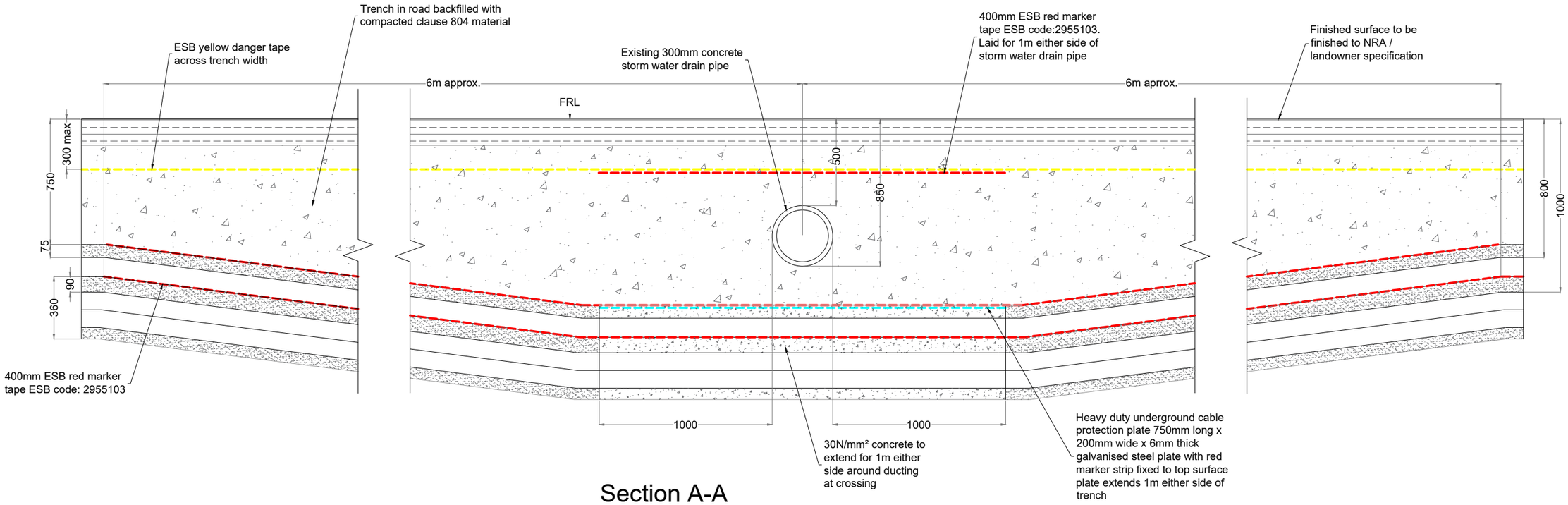
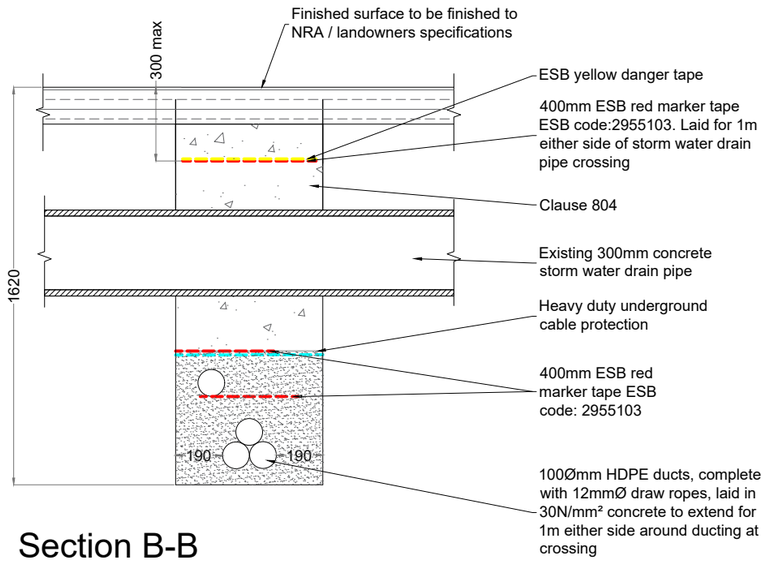


Section A-A

Scale 1:25



Section B-B

Scale 1:25

DRAWING TITLE:
Typical Cable Trench Under Piped Culvert - Option 2

PROJECT TITLE:
Cahermurphy Wind Farm Two, Co. Clare

DRAWING BY:	CHECKED BY:
Joseph O Brien	Michael Watson
PROJECT No.: 170238	DRAWING No.: Fig 4-28
SCALE: 1:25 @ A3	DATE: 02.09.2020

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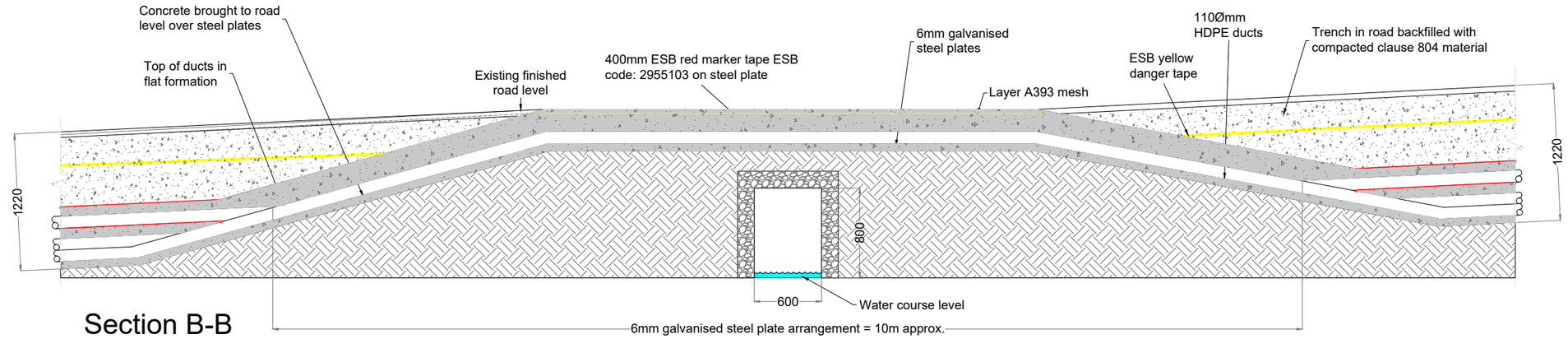

Section B-B

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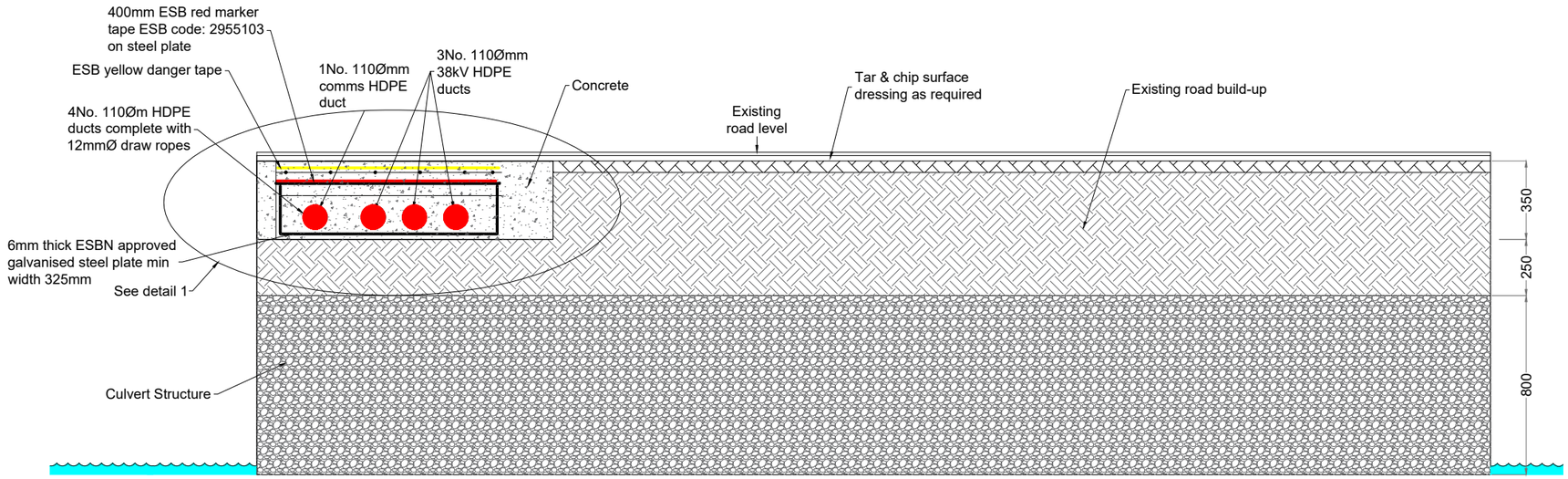
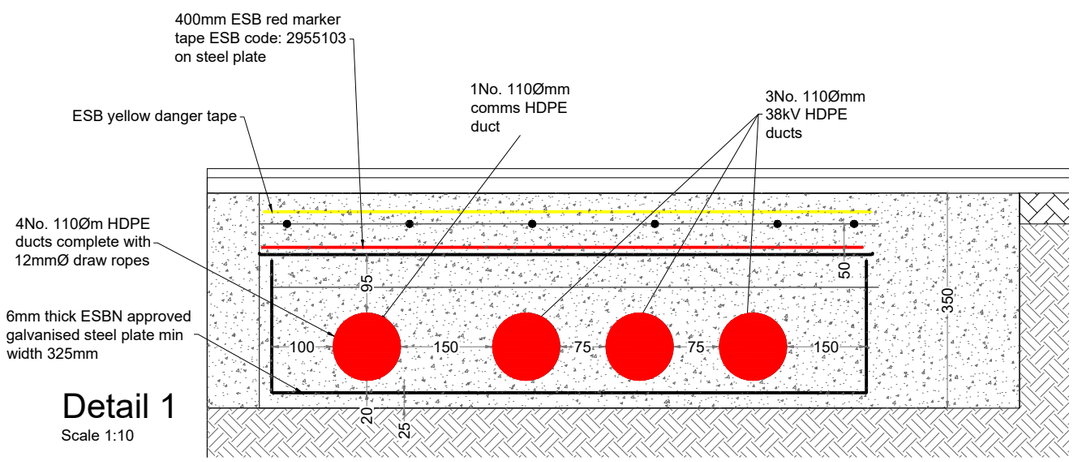


Section A-A

Scale 1:25



Detail 1

Scale 1:10

DRAWING TITLE:
Typical Cable Trench Flatbed Formation Over Culvert - Option 3

PROJECT TITLE:
Cahermurphy Wind Farm Two, Co. Clare

DRAWING BY:	CHECKED BY:
Joseph O Brien	Michael Watson
PROJECT No.: 170238	DRAWING No.: Fig 4-29
SCALE: As Shown @ A3	DATE: 02.09.2020

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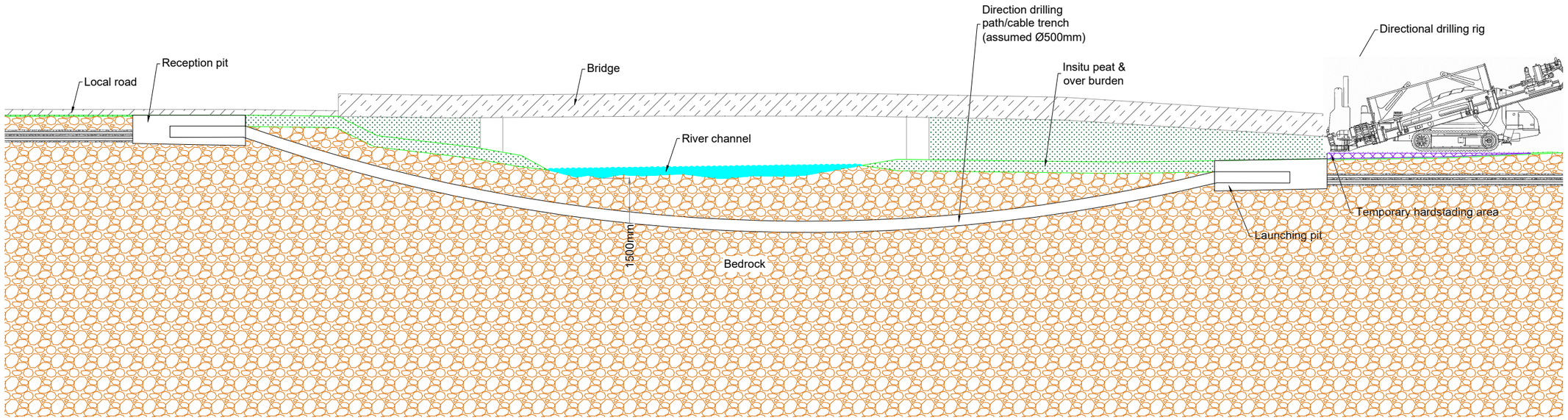

Typical Directional Drilling Rig

Typical Drilling Rig & Launch Pit

DRAWING TITLE:
Typical Directional Drilling - Option 4

PROJECT TITLE:
Cahermurphy Wind Farm Two, Co. Clare

DRAWING BY:	CHECKED BY:
Joseph O Brien	Michael Watson
PROJECT No.: 170238	DRAWING No.: Fig 4-30
SCALE: 1:200 @ A3	DATE: 02.09.2020

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Table 4-4 Grid Connection Route – Watercourse Crossings Methodology

Watercourse Crossing Reference No.	Watercourse Type	Cover from Road Level to Top of Culvert (mm) [1]	Maximum Depth of Trench from Road Level Under Culvert (mm) [1]	Crossing Option Description	Watercourse Crossing Option	Extent of In-Stream Works
1	Open channel	N/A	N/A	Where no crossing currently exists, the cable will pass over the watercourse over a bottomless box culvert or pre-cast concrete slab in a standard trefoil arrangement.	Option 1	None. No in-stream works required.
2	Concrete pipe	500	N/A	Where the required depth above the culvert to accommodate the standard trench cannot be achieved, the cabling will pass over the culvert in a flatbed formation.	Option 3	None. No in-stream works required.
3	Open channel	N/A	N/A	Where no crossing currently exists, the cable will pass over the watercourse over a bottomless box culvert or pre-cast concrete slab in a standard trefoil arrangement.	Option 1	None. No in-stream works required.
4	Open channel	N/A	N/A	Where no crossing currently exists, the cable will pass over the watercourse over a bottomless box culvert or pre-	Option 1	None. No in-stream works required.

Watercourse Crossing Reference No.	Watercourse Type	Cover from Road Level to Top of Culvert (mm) [1]	Maximum Depth of Trench from Road Level Under Culvert (mm) [1]	Crossing Option Description	Watercourse Crossing Option	Extent of In-Stream Works
				cast concrete slab in a standard trefoil arrangement.		
5	Stone culvert	N/A	N/A	Where the required depth above the culvert to accommodate the standard trench cannot be achieved, the cabling will pass over the culvert in a flatbed formation.	Option 3	None. No in-stream works required.
6	Stone culvert	N/A	N/A	Where the required depth above the culvert to accommodate the standard trench cannot be achieved, the cabling will pass over the culvert in a flatbed formation.	Option 3	None. No in-stream works required.
7	Stone culvert	N/A	N/A	Where the required depth above the culvert to accommodate the standard trench cannot be achieved, the cabling will pass over the culvert in a flatbed formation.	Option 3	None. No in-stream works required.
8	Open channel	N/A	N/A	Where no crossing currently exists, the cable will pass over the watercourse	Option 1/ Option 4	None. No in-stream works required.

Watercourse Crossing Reference No.	Watercourse Type	Cover from Road Level to Top of Culvert (mm) [1]	Maximum Depth of Trench from Road Level Under Culvert (mm) [1]	Crossing Option Description	Watercourse Crossing Option	Extent of In-Stream Works
				over a bottomless box culvert or pre-cast concrete slab in a standard trefoil arrangement. In the event that Option 1 is not appropriate, directional drilling will be utilised.		
9	Open channel	N/A	N/A	Where no crossing currently exists, the cable will pass over the watercourse over a bottomless box culvert or pre-cast concrete slab in a standard trefoil arrangement. In the event that Option 1 is not appropriate, directional drilling will be utilised.	Option 1/ Option 4	None. No in-stream works required.

Backfilling of launch & reception pits will be conducted in accordance with the normal specification for backfilling excavated trenches. Sufficient controls and monitoring will be put in place during drilling to prevent frack-out, such as the installation of casing at entry points where reduced cover and bearing pressure exits. The directional drilling methodology is further detailed in Figure 4-30.

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 battery storage components and site tracks will also require periodic maintenance. 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 will be decommissioned fully. The onsite substation will remain in place as it will be under the ownership of the ESB and will form a permanent part of the national electricity grid.

Upon decommissioning of the Proposed Development, the wind turbines will be disassembled in reverse order to how they were erected. All above ground turbine components will be separated and removed off-site for recycling. Turbine foundations will remain in place underground and will 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 left in situ, as appropriate to facilitate on-going forestry operations. 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, however, this is not envisaged at this time. Underground cables, including grid connection, will be removed and the ducting left in place. A decommissioning plan will be agreed with the local authorities three months prior to decommissioning the Proposed Development. The principles that will inform the final decommissioning plan are contained in the CEMP in Appendix 4.4.

5. POPULATION AND HUMAN HEALTH

5.1 Introduction

This section of the Environmental Impact Assessment Report (EIAR) assesses the potential effects of the proposed Cahermurphy Two Wind Farm development (the 'Proposed Development') on population and human health and has been completed in accordance with the guidance set out by the Environmental Protection Agency (EPA), in particular the '*Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports'* (EPA, August 2017). 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 human beings, as individuals or communities, should experience no significant diminution in their quality of life from the direct, indirect or cumulative impacts arising from the construction and operation of a development. Ultimately, all the impacts of a development impinge on human beings, directly and indirectly, positively and negatively. The key issues examined in this section of the EIAR relate to population and human health and incorporate population statistics, employment and economic activity, land-use, residential amenity (shadow flicker, noise, visuals and telecommunications), community facilities and services, tourism, property values, accidents/natural disasters, health and safety and other environmental hazards such as water contamination, air pollution, traffic and flooding.

There are 56 occupied dwellings located within one kilometre of the turbine locations with 15 dwellings belonging to the landowners who form part of the proposed Cahermurphy Two Wind Farm. The proposed development achieves a 700m set back from any occupied dwellings which is in excess of 4 times tip height set back.

5.1.1 Statement of Authority

This section of the EIAR has been prepared by Eoin O'Sullivan and reviewed by Michael Watson, both of MKO. Eoin is an experienced geo-environmental scientist and has over ten years' experience in the assessment of a wide range of energy and infrastructure related projects and working in the fields of environmental and human health risk assessment, waste management, waste policy and permitting. Eoin has wide experience in the project management of large scale infrastructural projects and brownfield developments and has routinely undertaken detailed quantitative risk assessment for the protection of controlled waters and ground gas risk assessments. Eoin holds an MSc in Environmental Engineering and is a Chartered Member of the Chartered Institute of Water and Environmental Management (CWEM) and Chartered Environmentalist (CEnv) with the Society of Environment. Michael has over seventeen years' experience in the environmental sector and had worked for the Geological Survey of Ireland and then a prominent private environmental & hydrogeological consultancy prior to joining MKO in 2014. Michael completed an MA in Environmental Management at NUI, Maynooth in 1999. Michael is a professional geologist (PGeo) and full member of IEMA (MIEMA) as well as a Chartered Environmentalist (CEnv).

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 Clare Development Plan 2017 – 2023 and Fáilte Ireland. 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 in a number of townlands as listed in Table 1.1 of Section 1.1 of this EIAR. The proposed wind farm site is located approximately 5 kilometres to the north of Kilmihil and 25 kilometres southwest of Ennis, Co. Clare. The site location is shown in Figure 1.1 of Chapter 1 of this EIAR on Introduction.

In order to assess the population in the vicinity of the site, 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 wind farm site lies predominantly within Mullagh, Knocknaboley, Cahermurphy and Creegh DEDs as shown in Figure 5-1. All 4 no. of these DEDs will collectively be referred to hereafter as the Study Area for this chapter.

The Study Area has a population of 1,116 persons, as of 2016 and comprises of a total land area of 87.09 square kilometres. (Source: CSO Census of the Population 2016).

In order to assess the population along the grid connection route, a review of properties and planning applications in the vicinity of the proposed grid works was carried out. The active construction area for the grid connection will be small, ranging from 150 to 300 metres in length at any one time, and it will be transient in nature as it moves along the route. Should separate crews be used during the construction phase they will generally be separated by one to two kilometres. The findings of the population review indicated that where development occurs along the route, the lands nearby comprise farm dwellings and assoicated farm buildings and derelict buildings and thus the population is very sparse. The land-use along the grid connection comprises commercial forestry, agriculture and public roads.

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 Clare grew by 1.4% to 118,817 persons. Other population statistics for the State, County Clare 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 Clare	117,196	118,817	1.4
Study Area	1,193	1,116	-6.5

The data presented in Table 5.1 shows that the population of the Study Area decreased by 6.5% between 2011 and 2016. When the population data is examined in closer detail, it shows that the rate of population growth within the Study Area has been unevenly spread through the District Electoral Divisions (DEDs). The highest rate of population increase between 2011 and 2016 occurred within Cahermurphy DED, which experienced a 2.6% population increase. In comparison, the population of Mullagh DED decreased by 13.8% during the same time period. Knocknaboley and Creegh DEDs also experienced decreases in population of 3.9% and 8.4%, respectively.

Map Legend

- EIAR Study Boundary
- District Electoral Divisions (DEDs)

095 Knocknaboley

099 Mullagh

081 Creegh

077 Cahermurphy

MAP TITLE: **Population and Human Health Study Area**	MAP NO.: **Figure 5.1**	SCALE: **1:65,000**
PROJECT TITLE: **Cahermurphy Two Wind Farm**		DATE: **13-07-2020**
DRAWING BY: **Eoin O'Sullivan**	CHECKED BY: **Michael Watson**	ISSUE NO.: **170238-2020.07.13-D4**

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Of the DEDs that make up the Study Area for this assessment, the highest population was recorded in Creegh DED, with 427 persons recorded during the 2016 Census. The lowest population was recorded in Mullagh DED, with 193 persons recorded during the 2016 Census.

5.2.3 Population Density

The population densities recorded within the State, County Clare and the Study Area during the 2011 and 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	67.49	70.05
County Clare	33.97	34.44
Study Area	13.70	12.81

The population density of the Study Area recorded during the 2016 Census was 12.81 persons per square kilometre. This figure is significantly lower than the national population densities of 70.05 persons per square kilometre and the county population densities of 34.44 persons per square kilometre recorded for County Clare.

Similar to the trends observed in population, the population density recorded across the Study Area varies between DEDs. Knocknaboley DED has the lowest population density, at 9.1 persons per square kilometre, while Creegh DED has the highest population density, at 21.01 persons per square kilometre.

5.2.4 Household Statistics

The number of households and average household size recorded within the State, County Clare 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 House-holds	Avg. Size (persons)	No. of House-holds	Avg. Size (persons)
State	1,654,208	2.7	1,702,289	2.7
County Clare	42,648	2.7	43,469	2.7
Study Area	454	2.7	434	2.6

In general, the figures in Table 5-3 show that while the number of households within the State and County have increased slightly, the average number of people per household has stayed the same, i.e. there are more households and the same amount of people per house. In contrast, the number of households and the number of people per household within the Study Area have decreased, i.e. there are less households and less people per house. However, the average household size recorded across

the Study Area varies between DEDs. Creegh DED had the highest, with 2.9 and 2.7 persons per household recorded in 2011 and 2016 respectively. Whereas, Cahermurphy DED recorded the lowest, with 2.4 and 2.5 persons per household recorded in 2011 and 2016, respectively.

5.2.5 Age Structure

Table 5-4 presents the percentages of the State, County Clare and Study Area population 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	21.1%	12.1%	29.5%	23.8%	13.4%
County Clare	21.5%	11.5%	26.2%	26.0%	14.9%
Study Area	16.8%	13.6%	19.4%	29.8%	20.3%

The proportion of the Study Area population within each age category is broadly similar to those recorded at national and County level for most categories, Within the Study Area, the highest population percentage occurs within the 45-64 age category.

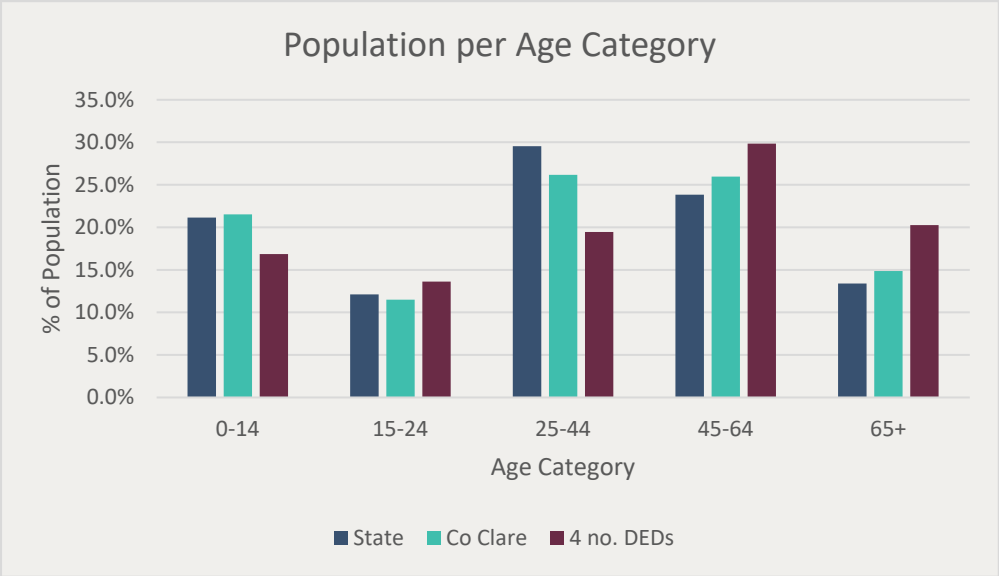

Figure 5.2 Population per Age Category in 2016 (Source: CSO)

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, e.g. 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 Clare and the Study Area during 2016.

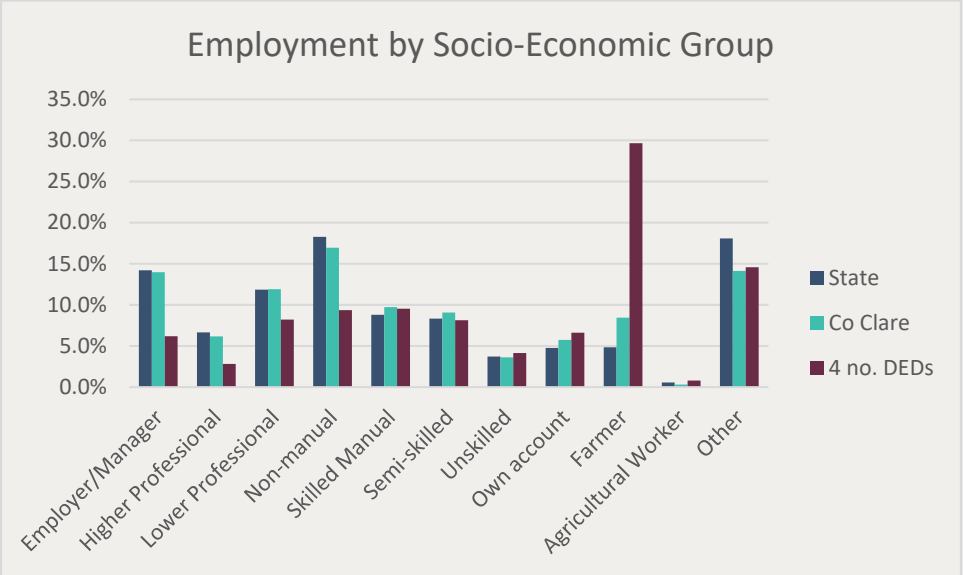

Figure 5.3 Employment by Socio-Economic Group in 2016 (Source: CSO)

The highest levels of employment within the Study Area were recorded in the Farmer category. The levels of employment within the Employer/Manager, Higher Professional, Lower Professional and Non-manual in the Study Area were lower than those recorded for the State and County Clare, while those recorded within the Unskilled, Own Account, Farmer and Agricultural Worker were higher.

The CSO figures for socio-economic grouping have a limitation of including the entire population, rather than just those who are in the labour force. It is likely that this is what gives rise to the high proportion of the population shown to be in the 'Other' category in Figure 5.3.

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.*' The results of the research indicate that the majority of jobs created as a result of wind energy development in Ireland are likely to be in the industry category, followed by grid jobs and finally potential manufacturing jobs. The creation of jobs would be as a result of a major programme of investment in wind energy.

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 Ireland's 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."*

As of April 2020, there were 5,030 Megawatts (MW) of wind energy capacity installed on the island of Ireland[1]. 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.

The Sustainable Energy Authority of Ireland estimates, in their 2011 report, '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.

[1] https://www.iwea.com/about-wind/facts-stats

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 recent report by Baringa has analysed the financial impact for end consumers of the deployment of wind generation in Ireland over the period 2000-2020 (*Wind for a Euro - Cost-benefit analysis of wind energy in Ireland 2000-2020, January 2019*). 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. This tallies with the Deloitte report which indicated that more wind energy feeding into the national grid would result in lower and more stable energy costs for consumers.

The proposed development will, if consent is granted, contribute to the economic value that renewable energy brings to the country.

5.2.7 Land-Use

As previously noted, the majority of the wind farm site is commercial forestry with a small proportion of farmland and turbary noted on the site. The surrounding land use within the Study Area is a mixture of farmland, wind farms and commercial forestry. The total area of farmland within the 4 DEDs around the wind farm site measures approximately 5,629 hectares, comprising 65% of the Study Area, according to the CSO Census of Agriculture 2010. There are 214 farms located within the 4 DEDs, with an average farm size of 26.3 hectares. This is slightly smaller than the average farm size of 32.6 hectare for Co. Clare.

Within the Study Area, farming employs 405 people, and the majority of farms are family-owned and run.

Table 5-5 shows the breakdown of farmed lands within the 4 DEDs. Pasture accounts for the largest proportion of farmland, followed by silage.

Table 5-5 Farm Size and Classification within the area of the wind farm in 2010 (Source: CSO)

Characteristic	Value
Size of 4 DEDs	8,709 hectares

Characteristic	Value
Total Area Farmed within 4 DEDs	5,629 hectares
Farmland as % of 4 DEDs	65%
Breakdown of Farmed Land	**Area (hectares)**
Total Pasture	3,032 ha
Total Silage	1,725 ha
Grazing	591 ha
Total Hay	276 ha
Total Potatoes	0 ha
Total Cereals	0 ha
Total Crops	5 ha

5.2.8 Services

The proposed development site is located approximately 5 kilometres to the north of Kilmihil; where local amenities including a community centre, church and shop are located.

5.2.8.1 Education

The closest national schools to the proposed development site is Cahermurphy National School which is located approximately 1.2 kilometres to the southeast of the nearest turbine and Clohanbeg National School, Cree which is located approximately 1.7 kilometres to the west of the nearest turbine. The nearest secondary school is St Michaels Community College, Kilmihil which is located approximately 5 kilometres to the south of the site.

5.2.8.2 Access and Public Transport

The proposed development site is accessed via local roads off the R484 Regional Road and N68 National Secondary Road to the south of Kilmihil. The site is not served directly by public transport. The nearest bus service runs from Kilmihil, approximately 5 kilometres south of the proposed development site. From Kilmihil, two daily connections are available, including to Kilrush, Ennis and Kilkee.

5.2.8.3 Amenities and Community Facilities

The majority of amenities and community facilities, including GAA and other sports clubs, youth clubs and recreational areas available in the area are located in the centres of settlement throughout the wider area. Retail and personal services within the vicinity are provided in the larger settlements such as Kilrush and Ennis. Facilities and services such as Church's, Post Offices, Garda Stations and GAA clubs are located in the villages of Kilmihil and Mullagh which are located approximately 5 kilometres to the south and northwest of the proposed development site, respectively.

There are no designated walking or cycling routes located within the Study Area for the Human Beings assessment. The nearest designated walking route is the Kilmihil Slí na Sláinte, located approximately 5 kilometres south of the proposed development site.

Community Benefit proposals, which would enhance local amenities and community facilities, are described in Section 4.5 of this EIAR, 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 €9.4 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').

Table 5-6 Overseas Tourists Revenue and Numbers 2018 (Source: Failte Ireland)

Region	Total Revenue (€m)	Total Number of Overseas Tourists by Region (000s)
Dublin	€2,095	6,309
Mid East/Midlands	€393	1,030
South-East	€261	1,028
South-West	€987	2,512
Mid West	€511	1,497
West	€727	1,963
Border	€244	752
Total	€5,218	15,091

The Mid-West, in which the site of the proposed development is located, comprises Counties Clare, Limerick and Tipperary. This Region benefited from approximately 10% of the total number of overseas tourists to the country and approximately 10% of the total tourism income generated in Ireland in 2018.

Although the data for 2018 is not available, Table 5.7 presents the breakdown of overseas tourist numbers and revenue to the Mid-West region during 2017 ('2017 *Topline Tourism Performance By Region*, Fáilte Ireland, August 2018). As can be observed in Table 5.7, County Clare had the highest number of overseas tourists within the Region during 2017.

Table 5.7 Overseas Tourism to Mid-West Region during 2017 (Source: Fáilte Ireland)

County	Revenue Generated by Overseas Tourists (€m)	No. of Overseas Tourists (000s)
Limerick	261	647
Clare	158	749
North Tipperary	23	53

5.3.2 Tourist Attractions

There are no key identified tourist attractions pertaining specifically to the site of the proposed development itself.

5.3.2.1 County Clare

Key tourist attractions within County Clare include the Cliffs of Moher, the Burren National Park and Bunratty Castle and Folk Park. Within the north and west of the county, many additional tourist attractions are found in Ennis, Miltown Maybay and Spanish Point, Lahinch and Liscannor, Creagh, Quilty, Lisdoonvarna, Kilfenora, Inagh, Doonbeg and Cooraclare, all of which lie within 20 kilometres of the proposed development site. The Discover Ireland website (www.discoverireland.ie) lists the following attractions within each location:

- Miltown Malbay and Spanish Point: bathing, golf, Willie Clancy Summer School for traditional Irish music.
- Lahinch and Liscannor: seaside resorts, surfing, bathing, golf.
- Creagh: scenic village known for its traditional Irish music.
- Quilty: small fishing village, Tromra Castle.
- Lisdoonvarna: Spa Wells Health Centre, annual Matchmaking Festival.
- Kilfenora: Burren National Centre, Church of St. Fachnan.
- Inagh: Biddy Early Pub Brewery, St. Tola Farm property cheese.
- Doonbeg: golf, seaside and surfing.
- Cooraclare: salmon and sea trout fishing in the Doonbeg River.

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. This 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. However the report also concluded that *'Although this study does not suggest that there is any direct relationship between tourism sector growth and wind farm development, it does show that wind farms do not cause a decrease in tourism employment either at a local or a national level.'*

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 or not 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.

With regard to 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 results of the survey indicate 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 had to the *Wind Energy Development Guidelines for Planning Authorities*' (DOEHLG 2006) *'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 Wind Energy Development Guidelines* (December 2019). 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 5.4 below.

5.4 Public Perception of Wind Energy

5.4.1 Sustainable Energy Ireland Survey 2003

5.4.1.1 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.

5.4.1.2 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.

5.4.1.3 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."*

5.4.1.4 Survey Update 2017

Additionally, a survey carried out by Interactions in October 2017, published by the IWEA, 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 IWEA 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 Study of Community Wind Energy Development in the Parish of Kilmihil 2004

5.4.2.1 Background

The *'Study of Community Wind Energy Development in the Parish of Kilmihil'* was carried out by E-Training International in 2004 for the Clare Energy Action Network (CLEAN) in conjunction with Rural Resource Development and EIRÍ Corca Baiscinn. The purpose of the survey was to assess levels of support or opposition to the development of wind farms. The survey considered the attitudes of rural landowners towards both wind energy development in general and towards the location of wind turbines in their own area and the possible level of interest in investing in such enterprises.

5.4.2.2 Study Area

This study involved a survey of all farming and non-farming households in the parish of Kilmihil, which was taken as an example of a typical County Clare parish. Kilmihil parish is a rural area. It lies in southwest County Clare, and forms part of the Kilrush Rural District. It comprises 21 townlands and the only centre of population is the village of Kilmihil, which had a population of 321 residents at the time of completing the survey. Kilmihil village is located approximately 5 kilometres south of the proposed EIAR site boundary.

5.4.2.3 Findings

Of the 400 survey forms that were distributed within Kilmihil parish, 280 were returned, i.e. a 70% response rate. Overall, a large majority of those surveyed were found to be favourable towards energy from wind farms. The findings of the survey include:

- Of the 125 landowner surveys that were returned, 96.5% were in favour of wind energy development. Of the 125 landowners, 71.2% were suckler farmers.
- 91.6% of farmers were in favour of wind farms being developed in their area by local farmers/community, while 54.2% were not in favour of wind farms being developed by private companies with no connection to the community.
- 53.7% of farmers indicated that they would be interested in investing in a local wind energy project.
- 63.8% of farmers were interested in developing a wind energy project as part of a community enterprise/co-operative.
- 65.2% of farmers indicated that additional income would be their major reason for considering getting involved in a wind energy project.

With regards to householders, the following findings were made:

- 87.9% of respondents were in favour of energy produced from wind farms, 8.8% were undecided and 3.4% were not in favour.
- 81.3% of householders were in favour of wind farms being developed by local farmers/community, while 66% were opposed to wind farm development by a company with no connection to the local community.

5.4.2.4 Conclusions

The overall conclusions to the Kilmihil parish survey state that the vast majority of respondents are in favour of the development of wind energy projects in their area. The survey also shows that developments that afford the local community the opportunity to invest and/or have some level of ownership over the project are clearly favoured over projects by private interests external to the community.

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 close 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-ism does not adequately explain variations in public attitudes due to the degree of subjectivity involved.

5.4.4 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 either 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." In the same survey, 30 to 31% neither favour/opposed, 6 to 7% tended to oppose and 9 to 11% strongly opposed.

The IWEA November 2019 survey follows previous national opinion polls asking the same questions 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 wind energy in recent years.

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 also 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 arising 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, in particular, 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, is in contrast to 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 a number of 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 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 World Health Organisation (WHO) Environmental Noise Guidelines for the European Region that was published in October 2018 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 L_{den}, as wind turbine noise above this level is associated with adverse health effects.*
>
> *No recommendation is made for average night noise exposure L_{night} of wind turbines. The quality of evidence of night-time exposure to wind turbine noise is too low to allow a recommendation.*
>
> *To reduce health effects, the GDG conditionally recommends that policymakers implement suitable measures to reduce noise exposure from wind turbines in the population exposed to levels above the guideline values for average noise exposure. No evidence is available, however, to facilitate the recommendation of one particular type of intervention over another."*

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

The WHO Environmental Noise Guidelines aim to support the legislation and policy-making process on local, national and international level, thus shall be considered by Irish policy makers for any future revisions of Irish National Guidelines.

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 L_{den} is converted from original sound pressure level values. The conversion requires, as variable, the statistical distribution of annual wind speed at a particular height, which depends on the type of wind turbine and meteorological conditions at a particular geographical location. Such input variables may not be directly applicable for use in other sites. They are sometimes used without specific validation for a particular area, however, because of practical limitations or lack of data and resources. This can lead to increased uncertainty in the assessment of the relationship between wind turbine noise exposure and health outcomes. Based on all these factors, it may be concluded that the acoustical description of wind turbine noise by means of L_{den} or L_{night} may be a poor characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes...*
>
> *...Further work is required to assess fully the benefits and harms of exposure to environmental noise from wind turbines and to clarify whether the potential benefits associated with reducing exposure to environmental noise for individuals living in the vicinity of wind turbines outweigh the impact on the development of renewable energy policies in the WHO European Region."*

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

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 EirGrid document '*EMF & You: Information about Electric & Magnetic Fields and the electricity transmission system in Ireland*' (EirGrid, 2014) provides further practical information on EMF and is included as Appendix 5-2 of this EIAR.

Further details on the potential impacts of electromagnetic interference to telecommunications and aviation are presented in Section 15.2 of this EIAR.

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 1.7.2 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.

A wind farm is not a recognised source of pollution. It is not an activity that falls within any thresholds requiring Environmental Protection Agency licensing under the Environmental Protection Agency

Licensing 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 during construction, operation or decommissioning for the reasons explained below in this section and on the basis of published research discussed in Section 5.5.

Chapters 9 Land, Soils & Geology, Chapter 10 Hydrology & Hydrogeology, Chapter 11 Air & Climate and Chapter 12 Noise & Vibration 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 and noise and vibration emissions. The assessments however show that the residual impacts are not significant and will not lead to significant effects on any environmental media. On this basis the potential for negative health effects associated with the proposed development is negligible.

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 11 which will contribute to positive effects on human health.

As set out in Chapter 10, 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 groundwater protection zones in the area of the proposed wind farm site. For the purposes of the assessment, it is assumed that every private dwelling down hydraulic gradient of the proposed development has a water supply well associated with it. The majority of these dwellings are very remote to the development site and it is very unlikely that there would be any hydraulic connection between any potential wells and groundwater flow from the development site. The groundwater flow direction in the aquifer underlying the site is assumed to mimic topography whereby flow paths will be from topographic high points to lower elevated discharge areas at streams and rivers. Flow paths are thought to be between 30 – 300m in length and given the fact that all dwelling houses are more 500m away there is a low risk of impact on local wells supplies as a result of the proposed development.

The proposed site design and mitigation measures outlined in Chapter 10 ensures that the potential for impacts on the water environment are not significant. No impacts on local water supplies are anticipated.

The Flood Risk Assessment has also shown that the risk of the proposed wind farm contributing to downstream flooding is also very low.

5.5.5 Vulnerability of the Project to Natural Disaster

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 and operational 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 Cahermurphy Two 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 landslides, flooding and fire. The risk of peat instability and failure occurring on the site is addressed in the Section 9.5.3.4 of Chapter 9 Land, Soils & Geology and the Geotechnical Peat Stability Assessment Report included in Appendix 9-1 The findings of the geotechnical assessment showed that the proposed development site has an acceptable margin of safety and is suitable for wind farm development. Overall, the peat characteristics on the Cahermurphy site are similar to that encountered on many developed wind farm sites. The risk of flooding is addressed in Chapter 10. 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. 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 is no potential effects from this source.

5.6 Property Values

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 of these LBNL studies note that their results don't 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're rare enough 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 of 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 Government's policy development on climate and the transition to a low carbon economy. A copy of the report is included as Appendix 5-3 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 do 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, 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 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 proposed wind farm site and the grid route is located on a site currently used for forestry with a small proportion used for agriculture and turbary, therefore a certain level of activity and traffic movements are associated with the site, which will assist in the assimilation of the proposed development into the receiving environment. There are no occupied properties located within approximately 700 metres of a proposed turbine location. As mentiond in Section 5.2 where development occurs along the grid route, the lands nearby comprise farm dwellings and assoicated farm buildings and derelict buildings and thus the population is very sparse.

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 (Chapter 6) refers to shadow flicker modelling, Chapter 12 of the EIAR addresses noise). A comprehensive landscape and visual impact assessment has also been carried out, as presented in Chapter 13 of this EIAR. Impacts on population and human health during the construction, operational and decomissioning phases of the proposed development are assessed in relation to each of these key issues and other environmental factors such as noise, traffic and dust; see Impacts in Section 5.8 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, see section Sections 5.8.3.10 and 5.8.5.7 below.

5.8 Likely Significant Impacts and Associated Mitigation Measures

5.8.1 'Do-Nothing' Scenario

If the proposed Project was not developed, the site will continue to function as it does at present, with no changes made to the current land-use of commercial forestry, turbary and agriculture.

If the Proposed Development were not to proceed, the opportunity to capture an even greater part of County Clare's valuable renewable energy resource would be lost, as would the opportunity to further 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.

5.8.2 Construction Phase

5.8.2.1 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.

A site-specific Emergency Response Plan (ERP) will be developed prior to the construction of the facility and will include details on the response required and the responsibilities of all personnel in the event of an emergency. The ERP in terms of health and safety will require updating and submissions from the various contractors and suppliers on appointment as the proposed project progresses.

The Environmental Manager will be responsible for any corrective actions required as a result of an incident e.g. an investigative report, formulation of alternative construction methods or environmental sampling, and will advise the Main Contractor as appropriate.

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 effects.

5.8.2.2 Employment and Investment

The design, construction and operation of the proposed wind farm and grid route will provide employment for technical consultants, contractors and maintenance staff. Up to 72 jobs could be created during the construction, operation and maintenance phases of the proposed development. The construction phase of the proposed development will last between approximately 12 – 18 months. The majority of construction workers and materials will be sourced locally where possible, 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 proposed 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 were over 3,400 jobs directly related to wind energy in Ireland in 2016, a figure which is projected to grow to over 8,000 by 2020.

Proposed Community Benefit Scheme

Two important areas of Government policy development which will have a bearing on the establishment of future community benefit funds, the draft Wind Energy Guidelines and the Renewable Energy Support Scheme (RESS), the terms and conditions for which were published in February 2020. Both sets of policy are expected to provide the Government requirements on future community benefit funds for renewable energy projects

MCRE expects that for each megawatt hour (MWh) of electricity produced by the wind farm, the project will contribute €2 into a community fund for the RESS period i.e. first 15 years of operation and €1 per MWh for the remaining lifetime of the wind farm. If this commitment is improved upon in upcoming Government Policy we will adjust accordingly.

If this project is constructed as currently designed we estimate that a total of approximately 5.6 million euro will be available in the local area for community funding over the lifetime of the project. The above figure is indicative only and will be dependent on the generation capacity of the wind farm which is influenced by a number of factors including:

1. *Number of wind turbines.*
2. *Capacity and availability of energy production of those turbines.*
3. *Quantity of wind*

The Community Benefit Fund belongs to the local community. The premise of the fund is that it should be used to bring about significant, positive change in the local area. To make this happen, our first task will be to form a benefit fund development working group that clearly represents both the close neighbours to the project as well as nearby communities. This group will then work on designing the governance and structure of a community entity that would administer the Community Benefit Fund. We aim to commence this work in summer 2020.

5.8.2.3 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.

5.8.2.4 Land-use

The existing land-uses of commercial forestry, agriculture and turbary will continue on the majority of the site of the proposed development and there will be no direct impact on this. Whilst there will be a change of land use to facilitate the development of the wind turbines and infrastructure, this is an acceptable and unavoidable part of the proposed development and as lands will be replanted elsewhere there is no net forestry loss as as result.

The existing land-use of forestry, agriculture and road networks will continue on the proposed grid connection route options. There will be a requirement to place an unbound surface layer over the grid connection route where it transverses forestry and agricultural land, as per ESB design requirements, in order to accommodate maintenance vehicles. This is an acceptable and unavoidable part of the proposed development.

5.8.2.5 Tourism and Amenity

Given that there are currently no tourism attractions specifically pertaining to the proposed development site there are no impacts associated with the construction phase of the proposed development. With regard to amenity use around the site, some traffic management safety measures may be in place, which temporarily affect the use of local roads. These measures will be short-term in duration and result in a slight, negative impact to motorists and cyclists. See Traffic impacts below for further details on proposed mitigation measures.

In terms of the proposed grid connection route options, as there will be some traffic restrictions in place through the construction phase, there may be a short-term slight negative impact to local tourism. Any impacts will however be limited to the active construction area (generally a 300m stretch of road) and will be temporary in nature. See Traffic impacts below for further details on proposed mitigation measures.

5.8.2.6 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. 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, and the extraction of stone from the borrow pit.

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 12 of this EIAR.

With regard to the proposed grid connection, construction works may give rise to noise impacts on sensitive receptors in the area, however these noise impacts will be temporary in nature as the works move along the grid connection route.

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. The measures will include the following, which are also described in detail in Chapter 12 of this EIAR:

- 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 Table 12-5 of Chapter 12 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 could occasionally be necessary to work out of these hours.

Where rock breaking is employed in relation to the proposed borrow pit location, the following are examples of measures that will be employed, where necessary, to mitigate noise emissions from these activities:

- Fit suitably designed muffler or sound reduction equipment to the rock breaking tool to reduce noise without impairing machine efficiency.
- Ensure all leaks in air lines are sealed.
- Use a dampened bit to eliminate ringing.
- Erect acoustic screen between compressor or generator and noise sensitive area. When possible, line of sight between top of machine and reception point needs to be obscured.
- Enclose breaker or rock drill in portable or fixed acoustic enclosure with suitable ventilation.

Residual Impact

Following the implementation of the above mitigation measures, there will be a Temporary to Short-term Slight to Moderate 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 effects.

5.8.2.7 Air (Dust)

Pre-Mitigation Impacts

Potential dust emission sources during the construction phase of the proposed development include tree felling, upgrading of existing access tracks and construction of new access roads, turbine foundations, substation and grid route. 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.

Proposed Mitigation Measures

Aggregate material for the construction of roads and turbine bases will be sourced from the proposed borrow pit located within the main site of the proposed wind farm development, therefore limiting the distance needed to transport this material to the site. Truck wheels will be washed to remove mud and dirt before leaving the site. 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 during tree felling, along haul roads and around the borrow pit area 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.

The active construction area along the proposed grid connection route options will be small, ranging from 150-300 metres in length at any one time. Should separate crews be used during the construction phase they will generally be separated by 1-2 kilometres. All construction machinery will be maintained in good operational order while on-site, minimising any emissions that are likely to arise. Aggregate materials for the construction of the cabling route will be sourced from the on-site borrow pits to reduce the amount of emissions associated with vehicle movements.

Construction waste will arise on the project mainly from excavation and unavoidable construction waste including material surpluses and damaged materials and packaging waste. Waste management will be carried out in accordance with *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction & Demolition Projects* (2006) produced by the Department of Environment, Community and Local Government (DoECLGs). The expected waste volumes generated on site are unlikely to be large enough to warrant source segregation at the wind farm site. Therefore, all wastes streams generated on site will be deposited into a single waste skip which will be covered. This waste material will be transferred to a licensed /permitted Materials Recovery Facility (MRF) by a fully

licensed waste contractor where the waste will be sorted into individual waste streams for recycling, recovery or disposal. The facility will be local to the proposed development site to reduce the amount of emissions associated with vehicle movements. There are two licensed waste facilities located within 30 kilometres of the proposed development.

Potential dust emissions during the construction period will not be significant and will be relatively short-term in duration.

Residual Impact

Following implementation of mitigation measures as outlined above, residual impacts of dust generation from the construction phase will have a Short-term Imperceptible Negative Impact.

Significance of Effects

Based on the assessment above there will be no significant effects.

5.8.2.8 Traffic

Pre-Mitigation Impacts

It is proposed that large wind turbine components will be delivered to the site of the proposed development, from Dublin Port or Galway Port, via the N68 National Secondary Road. The proposed turbine transport route from the N68 National Secondary Road to the proposed development site has been assessed. From Ennis the turbines will be transported southwest along the N68 National Secondary Road before turning right on to the R484 Regional Road and transported northwest until they reach the village of Kilmihil. The turbines will pass straight through Kilmihil continuing on the R484 until it reaches Creegh. At Creegh, the turbines will turn right at the crossroad onto a local road passing Creegh North, Clooneenagh and Cahermurphy Hill after which it will take a sharp left onto a local road approaching the proposed wind farm development site from the south.

The delivery route for general HGV construction traffic will follow a more direct route to the site via the local road network from the village of Kilmihil. The construction phase of the proposed development will last for approximately 12 -18 months.The proposed turbine delivery and construction traffic routes to the site are shown in Figure 15.1 in Chapter 15 of this EIAR.

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 15.1 of this EIAR.

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 negative impact.

With regard to the proposed grid connection route, there is the potential for temporary nuisance to local road users and residents along the cabling route, giving rise to a temporary slight negative impact.

Proposed Mitigation Measures

The majority of aggregate materials for the construction of any additional site tracks will be obtained from the proposed borrow pit located within the main site of the proposed development. This will

significantly reduce the travel time and distances travelled by delivery and construction vehicles who would otherwise have had to leave site.

- A traffic management plan which is included in Appendix 4.4 of the EIAR 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. 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.
- 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.
- Reasonable access to residences, farms and businesses will be maintained at all times during any road closures associated with the cable works. The details of this will be agreed with the roads authority in advance of works taking place.
- 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.
- Liaison with the Clare County Council Road Section and An Garda Siochana, will be carried out during the delivery phase of the large turbine vehicles, when an escort for all convoys will be required.

Residual Impact

Residual impacts of traffic from the construction phase of the wind farm will be Temporary Slight to Moderate Negative Impact

Residual impacts of traffic from the construction phase of the grid route will be Temporary Slight Negative Impact

Significance of Effects

Based on the assessment above there will be no significant effects.

5.8.3 Operational Phase

The effects set out below relate to the operational phase of the proposed wind farm.

5.8.3.1 Employment and Investment

The operational phase will present an opportunity for mechanical-electrical contractors and craftspeople to become involved with the maintenance and operation of the wind farm. On a long-term scale, the proposed development will create approximately 2 jobs during the operational phase relating to the maintenance and control of the wind farm, having a long-term slight positive effect.

Rates payments for the proposed wind farm will contribute significant funds to Clare County Council, which will be redirected to the provision of public services within the County. 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.

5.8.3.2 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.

5.8.3.3 Population

The operational phase of the proposed development will have no impact on the population of the area with regards to changes to trends, population density, household size or age structure.

5.8.3.4 Property Values

As noted in Section 5.6 above, the conclusions from available international literature indicate that property values are not impacted by the positioning of wind farms near houses. It is on this basis that it can be reasonably concluded that there would be a long-term imperceptible impact from the proposed development.

5.8.3.5 Land-use

The footprint of the proposed development site, including turbines, roads, grid route etc., will occupy only a small percentage of the total Study Area defined for the purposes of this EIAR. The main land-use of commercial forestry, agriculture and turbary in the EIAR primary study area will continue to co-exist with the proposed wind farm. The proposed development will have no impact on other land-uses within the wider area.

5.8.3.6 Noise

A baseline assessment of the existing background noise conditions was carried out, the results of which are presented in Chapter 12 of the EIAR. A noise assessment of the operational phase of the proposed development has also been carried out through modelling of the development using noise prediction software. The predicted noise levels for the proposed development have been compared with the existing background noise levels and the best practice guidance levels for noise emissions from wind farms.

Details of the noise assessment carried out by AWN Consulting are presented in Chapter 12 of the EIAR. The noise assessment determined that the predicted operational noise effect at the closest noise sensitive receptors to the site is of a moderate, negative, long-term nature. It is noted that this effect considers the periods of greatest potential effect prior to mitigation, i.e. the worst-case scenario. For the majority of locations assessed, operation of the proposed turbines will have a slight, negative, long-term effect. The noise assessment notes that these effects should be considered in terms that the effect is variable, and that this assessment considers periods of the greatest potential effect.

As stated in the noise assessment in Chapter 12, it has been demonstrated that the relevant national guidance in relation to noise associated with proposed wind turbines can be satisfied, therefore the predicted impact associated with the operational turbines is long term and not significant. If required, a detailed curtailment strategy matrix will be finalised as part of the detailed design for the selected turbine technology to achieve the noise criteria at each of the noise sensitive locations.

5.8.3.7 Traffic

One to two service technicians may have to attend to the site of the proposed wind farm on a weekly basis during the operational phase of the project. A Traffic and Transportation Assessment (TTA) of the proposed development has been completed by Alan Lipscombe Traffic and Transport Consultants, the results of which are presented in Section 15.1 of this EIAR. The TTA found that there will be a

long-term imperceptible negative impact on traffic created during the operational phase of the proposed wind farm.

5.8.3.8 Renewable Energy Production and Reduction in Greenhouse Gas Emissions

Emissions from energy production accounted for 20.5% of Ireland's greenhouse gas emissions in 2016 (*'Ireland's Final Greenhouse Gas Emissions in 2016'*, EPA (April, 2018)). The National Climate Change Strategy 2007 – 2012 stated that electricity generation from renewable sources provides the most effective way of reducing the contribution of power generation to Ireland's greenhouse gas emissions. The proposed development will offer significant benefits in terms of renewable energy production and reductions in greenhouse gas emissions. In this regard, it will have a long-term significant positive impact. In total, it is estimated that 1,941,113 tonnes of carbon dioxide will be displaced over the proposed thirty-year lifetime of the wind farm. Please refer to the carbon calculation assessment in Chatper 11 Air & Climate.

5.8.3.9 Tourism and Amenity

The Department of the Environment, Heritage and Local Government's Wind Energy Development Guidelines for Planning Authorities 2006 state that *"the results of survey work indicate that tourism and wind energy can co-exist happily"*. It is not considered that the proposed development will affect any tourism infrastructure in the wider area. Wind farms are an existing feature in the surrounding landscape, which will assist in the assimilation of the proposed development into this environment.

5.8.3.10 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 with regard to potential interference from the proposed wind farm. Full details are provided in Section 2.6 of the EIAR (in Chapter 2: Background to the Proposed Development) and Section 15.2 of the EIAR (in Chapter 15: Material Assets – Telecommunications and Aviation). Copies of scoping replies received are presented in Appendices 2-1 of the EIAR.

Of the scoping responses received from telephone, broadband and other telecommunications operators, those who highlighted an initial potential interference risk are addressed in Section 15.2.4 in Chapter 15 Material Assets. 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 not subject to any interference risk, or do not operate any links in the area.

In June 2019, scoping responses were received from the Department of Defence and the Irish Aviation Authority which set out lighting requirements for turbines. Further detail in regard to aviation, is addressed in Section 15.2.4.2.3 in Chapter 15 Material Assets. The proposed development will comply with all turbine lightning requirements of the Department of Defence and Irish Aviation Authority.

The proposed wind farm will therefore have no impact on telecommunications or aviation communications.

5.8.3.11 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 shadow flicker and noise modelling have been carried out as part of this EIAR in Chapter 6 and Chapter 12 respectively, 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 13 of this EIAR. The proposed development has been designed to maximise turbine separation distances to dwellings in the area, with no turbines located within approximately 700 metres of an occupied dwelling. An assessment of roadside screening was carried out for roads within 5 kilometres of the proposed turbine locations, with both the methodology and findings of this described in Section 13.7.4.4 of this EIAR. Many of these roads have intermittent/partial 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, 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.

Proposed Mitigation Measures

There are no turbines proposed within approximately 700 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, cable route and construction materials haul route.

Residual Impact

The proposed development will have an imperceptible impact on residential amenity.

Significance of Effects

Based on the assessment above there will be no significant effects on residential amenity.

5.8.4 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 ESB/EirGrid. The access roads will also remain in place and will be used by Coillte for forestry operations.

The works required during the decommissioning phase are described in Section 4.10 in Chapter 4 of this EIAR. 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.

5.8.5 Cumulative Effects

For the assessment of cumulative impacts, any other existing, permitted or proposed developments (wind energy or otherwise) have been considered where they have the potential to generate an in-combination or cumulative impact with the construction, operational and decommissioning phases of the proposed Cahermurphy Two Wind Farm. Further information on projects considered as part of the cumulative assessment are given in Section 2.8 of this EIAR. The impacts with the potential to have cumulative impacts on human beings, in particular noise, air & climate, shadow flicker and visual impacts are addressed in the relevant chapters of this EIAR.

5.8.5.1 Employment and Economic Activity

There are 5 no. permitted/under construction wind farms and 8 no. operational existing wind farms sites located within 20 kilometres of the proposed wind farm site. These projects will contribute to short term employment during their construction stages and provide the potential for long-term employment resulting from maintenance operations. The rate payments from these projects will also contribute significant funds to Clare County Council, which will be redirected to the provision of public services within the County. This results in a long-term moderate positive impact.

The commercial forestry activities on the site of the proposed wind farm provides between 3-6 months of employment, either for harvesting or replanting per year. These activities can continue while the proposed wind farm is under construction and operating, resulting in a long-term moderate positive cumulative impact.

5.8.5.2 Tourism and Amenity

There are no key identified tourist attractions pertaining specifically to the site of the proposed development itself.

It is not considered that the proposed development together with other projects in the area will cumulatively affect any tourism infrastructure in the wider area. As mentioned previously, wind farms are an existing feature in the surrounding landscape, which will assist in the assimilation of the proposed development into this environment. As also noted in Section 5.3 above, the conclusions from available research indicate there is a generally positive disposition among tourists towards wind development in Ireland. It is on this basis that it can be concluded that there would be a long-term imperceptible cumulative impact from the proposed development and other wind farm developments in the area.

5.8.5.3 Traffic

All other wind farms, are either complete, or will be complete when the proposed development reaches the construction stage, resulting in no potential for cumulative impact between the proposed development and the neighbouring developments.

5.8.5.4 Air (Dust)

The nature of the proposed development is such that, once operational, it will have a long-term, moderate, positive impact on the air quality.

During the construction phase of the Proposed Development and the construction phase of other developments within 20 kilometres of the wind farm site 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 Section 11.2.4.2 and

Section 11.3.4.2 of Chapter 11 are implemented during the construction phase of the Proposed Development, there will be no cumulative negative effect on air and climate.

The nature of the Proposed Development and other wind energy developments within 20 kilometres are such that, once operational, they will have a cumulative long-term, significant, positive effect on the air quality and climate.

5.8.5.5 Health and Safety

The proposed wind farm will have no impacts in terms of health and safety. There is no credible scientific evidence to link wind turbines with adverse health impacts. All other existing, permitted or proposed developments (wind energy or otherwise) would be expected to follow all relevant Health and Safety Legislation during the construction, operation and decomissioning phases of the development. It is assumed also that all mitigation measures in relation to the other cumulative projects will also be implemented. It is on this basis that it can be concluded that there would be a long-term imperceptible cumulative impact from the proposed development and other developments in the area.

5.8.5.6 Property Values

As noted in Section 5.6 above, the conclusions from available international literature indicate that property values are not impacted by the positioning of wind farms near houses. It is on this basis that it can be concluded that there would be a long-term imperceptible cumulative impact from the proposed development and other wind farm developments in the area.

5.8.5.7 Services

The rate payments from the proposed development and other projects in the area will contribute significant funds to Clare County Council, which will be redirected to the provision of public services within the County. In addition, the injection of money into local services though the establishment of community benefit funds is also expected to be a long-term positive cumulative impact.

5.8.5.8 Residential Amenity

Pre-Mitigation Impacts
In the unlikely event of all permitted and proposed projects as described in the cumulative assessment in Section 2.8 of this EIAR being constructed at the same time, there is the potential for a resulting cumulative negative impact to occur on residential amenity. It is noted however that the permitted and proposed projects extend over a large geographical area with alternative delivery routes and therefore the residential amenity in promimity to the proposed development will not be significantly impacted.

Proposed Mitigation Measures
There are no turbines proposed within approximately 700 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 minimise insofar as possible impacts on residential amenity at properties located in the vicinity of the proposed development works, including along the proposed turbine, cable route 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 effects.

6. SHADOW FLICKER

6.1 Introduction

This section of the Environmental Impact Assessment Report (EIAR) describes the potential impacts of shadow flicker on human beings and human health and has been completed in accordance with the guidance set out by the Environmental Protection Agency (EPA), in particular the *'Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports'* (EPA, August 2017). The full description of the proposed development is provided in Chapter 4 of this EIAR.

6.1.1 Statement of Authority

This section of the EIAR has been prepared by Stephen Corrigan and reviewed by Eoin O'Sullivan and Michael Watson, all of MKO. Stephen is an Environmental Scientist with over three years' experience in private practice; where he has completed numerous assessments for shadow flicker. Stephen holds a BSc (Hons) in Environmental Science. Eoin is an experienced geo-environmental scientist and has over ten years' experience in the assessment of a wide range of energy and infrastructure related projects and working in the fields of environmental and human health risk assessment, waste management, waste policy and permitting. Eoin has also got extensive experience in the completion and review of shadow flicker assessments for wind farm projects. Eoin has wide experience in the project management of large scale infrastructural projects and brownfield developments and has routinely undertaken detailed quantitative risk assessment for the protection of controlled waters and ground gas risk assessments. Eoin holds an MSc in Environmental Engineering and is a Chartered Member of the Chartered Institute of Water and Environmental Management (CWEM) and Chartered Environmentalist (CEnv) with the Society of Environment. Michael has over seventeen years' experience in the environmental sector and had worked for the Geological Survey of Ireland and then a prominent private environmental & hydrogeological consultancy prior to joining MKO in 2014. Michael completed an MA in Environmental Management at NUI, Maynooth in 1999. Michael is a professional geologist (PGeo) and full member of IEMA (MIEMA) as well as a Chartered Environmentalist (CEnv) and also has extensive experience in the completion and review of shadow flicker assessments for wind energy projects.

6.2 Receiving Environment

The site of the proposed development is located in a number of townlands as listed in Table 1.1 of Section 1.1 of this EIAR. The proposed wind farm site is located approximately 5 kilometres to the north of Kilmihil and 25 kilometres southwest of Ennis, Co. Clare. The site located in county Clare, comprises lands at Mullagh, Creegh and Cahermurphy. The site location is shown in Figure 1.1 of Chapter 1 of this EIAR.

The study area for the shadow flicker assessment is ten times the rotor diameter from each turbine as set out in the *'Wind Energy Development Guidelines for Planning Authorities*', DoEHLG, 2006. All properties located within ten rotor diameters which is assumed to be 1.4 kilometres have been included in the assessment. The closest residential property is located approximately 700 metres from the nearest proposed turbine location.

6.3 Shadow Flicker

6.3.1 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 (*Wind Energy Development Guidelines for Planning Authorities*', DoEHLG, 2006).

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 well over 50% of the time. The mean cloud amount for each hour is between five and six okta. This is due to our geographical position off the northwest of Europe, close to the path of Atlantic low-pressure systems which tend to keep us in humid, cloudy airflows for much of the time. A study of mean cloud amounts at 12 stations over a 25-year period showed that the mean cloud amounts were at their minimum in April and their maximum in July. Cloud amounts were less by night than by day, with the mean minimum occurring roughly between 2100 and 0100 GMT and the mean maximum 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 500 metres between a turbine and a receptor, shadow flicker generally occurs only at sunrise or sunset when the shadow cast by the turbine is longer. At distances greater than ten rotor diameters from a turbine, the potential for shadow flicker is very low ('*Wind Energy Development Guidelines for Planning Authorities*', DoEHLG, 2006). Figure 6-1 illustrates the shadow cast by a turbine at various times during the day, where 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.

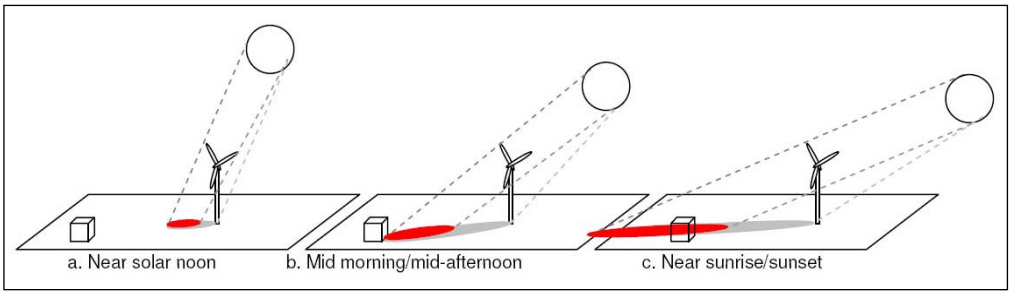

Figure 6-1 Shadow-Prone Area as a Function of Time of Day (Source: Shadow Flicker Report, Helimax Energy, December 2008)

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 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 have to be facing directly toward or away from the sun (ie. perpendicual to it), so they are moving across the source of the light relative to the observer. This is demonstrated in Figure 6-2.

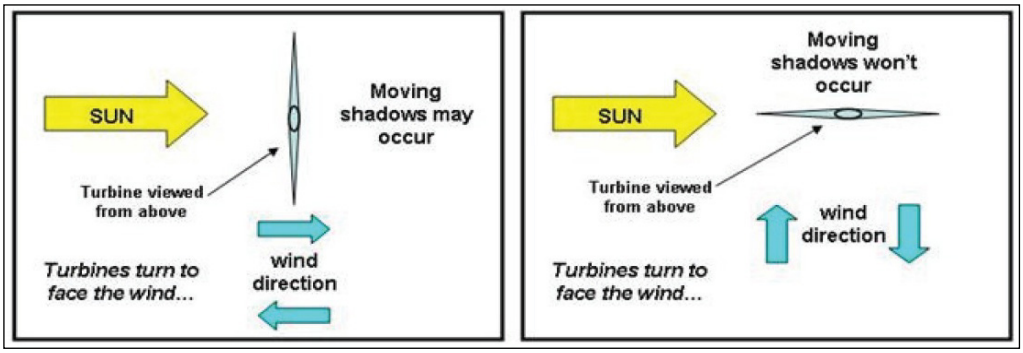

Figure 6-2 Turbine Blade Position and Shadow Flicker Impact (Source: Wind Fact Sheet: Shadow Flicker, Noise Environment Power LLC)

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.

6.3.2 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 DoEHLG 2006 wind energy guidelines recommend that shadow flicker at 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 residential property is located approximately 700 metres from the nearest turbine location. Refer to Section 6.2.

The DoEHLG guidelines state that shadow flicker lasts only for a short period of time and occurs only during certain specific combined circumstances, as follows:

- the sun is shining and is at a low angle in the sky, i.e. just after dawn and before sunset, **and**
- the turbine is located directly between the sun and the affected property, **and**
- there is enough wind energy to ensure that the turbine blades are moving, **and**
- the turbine blades are positioned so as to cast a shadow on the receptor.

Although the DoEHLG thresholds apply to properties located within 500 metres of a proposed turbine location, for the purposes of this assessment, the guideline thresholds of 30 hours per year or 30 minutes per day have been applied to all properties located within ten rotor diameters (i.e. assumed at 1.4 kilometres as a worst-case scenario) of the proposed turbines within the proposed development site (as per IWEA guidelines, 2012). The 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 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).

At time of writing, the Draft Guidelines have not yet been adopted, and the relevant guidelines remain those published in 2006. Notwithstanding this, however, due to the timelines associated with the planning process for renewable energy projects, it is possible that a version of the draft guidelines may be finalised during the consideration period for the current proposed development. Towards this end it

is anticipated that Cahermurphy Two Wind Farm will be capable of adhering to the relevant shadow flicker standards, and is in accordance with the set back requirements. The assessment herein is based on compliance with the current DoEHLG Guidelines limit (30 hours per year or 30 minutes per day).

6.3.3 Scoping

Section 2.6 in Chapter 2 of this EIAR describes the scoping and consultation exercise undertaken for the proposed Cahermurphy Two Wind Farm. No comments were received in relation to Shadow Flicker in response to scoping requests as of July 2020.

6.3.4 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 Department of the Environment, Heritage and Local Government (DoEHLG) guidelines state that careful site selection, design and planning, and good use of relevant software can help avoid the possibility of shadow flicker in the first instance, all of which have been employed at the site of the proposed development. Proper siting of wind turbines is key to reducing or 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 the same day each year.

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.

Any potential shadow flicker 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 if the model indicates that an exceedance of the shadow flicker guideline limit might occur, as detailed further below.

6.3.5 Shadow Flicker Assessment Criteria

6.3.5.1 Turbine Dimensions

Planning permission is being sought for a turbine size envelope with a maximum tip height of up to 170 metres. For the purposes of this assessment, a turbine with a rotor diameter of 140 metres and a hub height of 100 metres was modelled in order to complete the assessment. 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 170-metre tip height envelope) 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 170 metres and the potential shadow flicker impact it will give rise to will be no more than the residual amount set out in this assessment. With the benefit of the mitigation

measures outlined in this section, any turbine to be installed onsite will be able to comply with the DoEHLG 2006 guidelines thresholds of 30 minutes per day or 30 hours per year, or with any revised guidelines if required, through the use of turbine control software.

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.

6.3.5.2 Study Area

There is a total of 100 No. properties including occupied, unoccupied/derelict, within a distance of 10 rotor diameters (assumed at 1,400 metres) from the proposed turbine locations.

The area was also the subject of a planning history search, to identify properties that may have been granted planning permission, but not yet been constructed however there are none within the study area. Of the 100 No. buildings, 96 are dwellings, 1 is Cahermurphy National School and 3 are derelict (formerly residential). The locations of the buildings are shown in Figure 6.3 below, with all buildings detailed in Table 6.1 in Section 6.3.6 below. Former residential dwellings termed as "derelict" within this assessment are defined as properties that are currently unoccupied and in an uninhabitable condition, but which may have the potential to be restored to their former use.

6.3.5.3 Assumptions and Limitations

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 additional incidences or durations or shadow flicker over and above those predicted in this assessment can be countered by extending the mitigation strategies outlined further 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.

Map Legend

- EIAR Study Boundary
- Proposed Turbine Location
- Shadow Flicker Study Area - 1,400m (10 x 140m Rotor Diameter) Distance from Turbines
- Dwelling Location

Creevagh Lough
Treanmanagh
Garrownagry
Cragbeg Br
Doolough Br
Sch
Illaunfreega Br
Drummin Br
Cillín
Boleybeg Lough
Drummin
Burial Ground
Knocknahila
Knocknadrummin
Lough Nacrag
Cragnashingaun
Cloghaun
Caheraghacullin
Gortaheera
Cahermurphy
Cahermurphy Hill
Creegh North Br
Cloonwhite North
Knockbrack
Clooneenagh
Clooneenagh Cross
Graveyard
Castlepark
Cairn
Holy Well
Kiltumper
Mound
Cloonwhite South
Caher Lo
un East

05 06 07 08 09 10 11 12 71 70 69 68 67

MAP TITLE: **Shadow Flicker Study Area**		MAP NO.: **Figure 6.3**	SCALE: **1:20,000**
PROJECT TITLE: **Cahermurphy Two Wind Farm**			DATE: **13-07-2020**
DRAWING BY: **Eoin O'Sullivan**	CHECKED BY: **Michael Watson**		ISSUE NO.: **170238-2020.07.13-D4**

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- 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 28.3% of the daylight hours per year. This percentage is based on Met Eireann data recorded at Shannon Airport over the 30-year period from 1981 to 2010 (www.met.ie). The actual sunshine hours at the proposed development site and therefore the percentage of time shadow flicker could actually occur is 28.3% of daylight hours. Table 6.1 below therefore lists the annual shadow flicker calculated for each property when the regional average of 28.3% sunshine is taken into account, to give a more accurate annual average shadow flicker prediction.

6.3.6 Shadow Flicker Assessment Results

6.3.6.1 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 is based on the assumption 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 28.3% has been applied.

The predicted maximum daily and annual shadow flicker levels are then considered in the context of the DoEHLG's guideline daily threshold of 30 minutes per day and annual threshold of 30 hours per year. If there is a predicted exceedance of the threshold limits at any property, the turbines that contribute to the exceedance are also identified.

The DoEHLG Wind Energy Guidelines recommend that shadow flicker at dwellings within 500 metres of a proposed turbine location should not exceed a total of 30 minutes per day or 30 hours per year. As detailed in Section 6.1 there are no residential properties within 700 metres of the proposed turbine locations. However, for the purposes of this assessment, the guideline threshold has been applied to all properties within 1,400 metres of the proposed turbine locations.

Note a total of 100 No. buildings have been modelled as part of the shadow flicker assessment, the results of which are presented in Table 6.1. Former residential dwellings termed as "derelict" within this assessment are defined as properties that are currently unoccupied and in an uninhabitable condition, but which may have the potential to be restored to their former use.

Table 6-1 Maximum Potential Daily and Annual Shadow Flicker

Building No.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Distance to Nearest Turbine (metres)	Nearest Turbine	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Giving Rise to Shadow Flicker Exceedance	Mitigation Strategy Required (for Potential Day Exceedance)?
1	509369	670139	700	6	01:13:48	113:36:00	32:08:56	3, 5, 6	Yes
2	509257	670291	767	6	01:04:48	103:42:00	29:20:50	3, 5, 6	Yes
3	509182	670334	774	3	01:09:00	109:42:00	31:02:42	2, 3, 5, 6	Yes
4	509020	670420	705	3	01:18:00	109:06:00	30:52:31	2, 3, 5, 6	Yes
5	509006	670480	741	3	01:06:00	83:48:00	23:42:55	2, 3, 5	Yes
6	509155	670491	851	3	00:55:48	71:18:00	20:10:40	3, 5, 6	Yes
7 (derelict)	508942	670546	756	3	01:02:24	69:24:00	19:38:25	2, 3	Yes
8	508817	671291	1408	3	00:00:00	00:00:00	0:00:00	-	No
9	508009	671016	1221	3	00:00:00	00:00:00	0:00:00	-	No
10	508188	670827	978	3	00:12:36	02:36:00	0:44:09	3	No
11	508432	671019	1112	3	00:00:00	00:00:00	0:00:00	-	No
12	509842	667929	1027	10	00:32:24	22:18:00	6:18:39	10	Yes

Building No.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Distance to Nearest Turbine (metres)	Nearest Turbine	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Giving Rise to Shadow Flicker Exceedance	Mitigation Strategy Required (for Potential Day Exceedance)?
13	510010	667945	1158	10	00:31:48	38:30:00	10:53:44	10	Yes
14 (derelict)	509849	667870	1069	10	00:21:36	08:54:00	2:31:07	10	No
15	509678	667839	964	10	00:00:00	00:00:00	0:00:00	-	No
16	509394	667682	936	10	00:27:36	11:36:00	3:16:58	9	No
17	509471	667575	1066	10	00:19:48	08:54:00	2:31:07	9	No
18	509382	667626	983	10	00:24:00	11:54:00	3:22:04	9	No
19	509244	667569	996	10	00:00:00	00:00:00	0:00:00	-	No
20	509338	667431	1154	10	00:00:00	00:00:00	0:00:00	-	No
21	509639	667356	1337	10	00:00:00	00:00:00	0:00:00	-	No
22	508905	667729	747	9	00:37:48	24:36:00	6:57:42	9	Yes
23	507564	668323	746	7	00:47:24	80:12:00	22:41:48	7, 9	Yes
24	507943	670573	802	2	00:48:36	56:48:00	16:04:28	3, 6	Yes
25	508042	670523	758	2	00:56:24	72:36:00	20:32:45	3, 6	Yes

Building No.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Distance to Nearest Turbine (metres)	Nearest Turbine	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Giving Rise to Shadow Flicker Exceedance	Mitigation Strategy Required (for Potential Day Exceedance)?
26	508016	670483	715	2	00:53:24	74:48:00	21:10:06	2, 3, 6	Yes
27	507960	670563	792	2	00:50:24	59:00:00	16:41:49	3, 6	Yes
28	508100	670495	725	3	01:21:36	95:54:00	27:08:23	1, 2, 3, 6	Yes
29	509696	668726	707	10	00:47:24	95:54:00	27:08:23	8, 10	Yes
30	509765	668730	775	10	00:43:12	74:06:00	20:58:13	8, 10	Yes
31	509804	668771	824	10	00:41:24	63:54:00	18:05:01	8, 10	Yes
32	509838	668861	848	8	00:40:12	71:54:00	20:20:52	6, 8, 10	Yes
33	509905	668819	921	8	00:37:12	65:48:00	18:37:17	6, 8, 10	Yes
34	509961	668863	968	8	00:35:24	71:42:00	20:17:28	6, 8, 10	Yes
35	510057	668847	1066	8	00:32:24	66:48:00	18:54:16	6, 8, 10	Yes
36	509579	667556	1133	10	00:00:00	00:00:00	0:00:00	-	No
37	508526	667475	742	9	00:00:00	00:00:00	0:00:00	-	No
38	508379	667449	739	9	00:00:00	00:00:00	0:00:00	-	No

Building No.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Distance to Nearest Turbine (metres)	Nearest Turbine	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Giving Rise to Shadow Flicker Exceedance	Mitigation Strategy Required (for Potential Day Exceedance)?
39	508559	667510	719	9	00:00:00	00:00:00	0:00:00	-	No
40	508702	667461	822	9	00:00:00	00:00:00	0:00:00	-	No
41	508973	667089	1279	9	00:00:00	00:00:00	0:00:00	-	No
42	509002	667115	1273	9	00:00:00	00:00:00	0:00:00	-	No
43	508298	667456	729	9	00:00:00	00:00:00	0:00:00	-	No
44	508275	667450	736	9	00:00:00	00:00:00	0:00:00	-	No
45	508204	667432	762	9	00:00:00	00:00:00	0:00:00	-	No
46	508117	667436	775	9	00:00:00	00:00:00	0:00:00	-	No
47	508162	667237	960	9	00:00:00	00:00:00	0:00:00	-	No
48	507578	667354	1108	9	00:00:00	00:00:00	0:00:00	-	No
49	507616	667411	1040	9	00:00:00	00:00:00	0:00:00	-	No
50	507712	667416	975	9	00:00:00	00:00:00	0:00:00	-	No
51	507762	667420	942	9	00:00:00	00:00:00	0:00:00	-	No

Building No.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Distance to Nearest Turbine (metres)	Nearest Turbine	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Giving Rise to Shadow Flicker Exceedance	Mitigation Strategy Required (for Potential Day Exceedance)?
52	507871	667414	888	9	00:00:00	00:00:00	0:00:00	-	No
53	507178	667859	1177	9	00:30:36	19:18:00	5:27:43	9	Yes
54	507181	667828	1182	9	00:30:36	20:00:00	5:39:36	9	Yes
55	507174	668003	1150	9	00:30:36	35:54:00	10:09:35	7, 9	Yes
56	507168	668123	1112	4	00:31:48	51:54:00	14:41:16	7, 9	Yes
57	507532	668235	779	9	00:43:12	53:06:00	15:01:38	7, 9	Yes
58 (derelict)	506984	668590	881	1	00:40:12	67:30:00	19:06:09	4, 7, 9	Yes
59	506900	668687	842	1	00:37:48	56:36:00	16:01:04	4, 7	Yes
60	506930	668696	817	1	00:39:00	63:24:00	17:56:32	4, 7	Yes
61	506920	668708	813	1	00:38:24	56:06:00	15:52:35	4, 7	Yes
62	506903	668759	782	1	00:37:48	46:12:00	13:04:29	4, 7	Yes
63	506827	668845	769	1	00:35:24	24:54:00	7:02:48	4	Yes
64	506824	668794	807	1	00:35:24	36:36:00	10:21:28	4, 7	Yes

Building No.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Distance to Nearest Turbine (metres)	Nearest Turbine	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Giving Rise to Shadow Flicker Exceedance	Mitigation Strategy Required (for Potential Day Exceedance)?
65 (school)	506168	668768	1356	1	00:27:36	30:06:00	8:31:06	1	No
66	506141	668759	1384	1	00:27:00	27:48:00	7:52:03	1	No
67	506204	668729	1343	1	00:28:12	31:54:00	9:01:40	1	No
68	506181	668729	1363	1	00:27:36	31:36:00	8:56:34	1	No
69	506235	668785	1289	1	00:28:48	34:06:00	9:39:01	1	No
70	506450	668783	1105	1	00:32:24	37:18:00	10:33:21	1, 4	Yes
71	506153	669205	1239	1	00:28:12	14:42:00	4:09:36	1	No
72	506302	669182	1096	1	00:31:48	19:24:00	5:29:25	1	Yes
73	506337	669172	1063	1	00:33:00	21:00:00	5:56:35	1	Yes
74	506376	669192	1022	1	00:34:12	22:24:00	6:20:21	1	Yes
75	506751	669073	700	1	01:07:12	107:42:00	30:28:45	1, 2, 4	Yes
76	506713	669161	703	1	01:16:12	114:06:00	32:17:25	1, 2, 4	Yes
77	506682	669253	711	1	01:09:00	81:00:00	22:55:23	1, 2, 4	Yes

Building No.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Distance to Nearest Turbine (metres)	Nearest Turbine	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Giving Rise to Shadow Flicker Exceedance	Mitigation Strategy Required (for Potential Day Exceedance)?
78	506534	669661	894	1	00:37:48	24:12:00	6:50:55	1	Yes
79	506490	669691	944	1	00:36:00	22:00:00	6:13:34	1	Yes
80	506478	669736	972	1	00:35:24	21:12:00	5:59:59	1	Yes
81	506473	669790	998	1	00:34:48	20:36:00	5:49:47	1	Yes
82	506475	669872	1033	1	00:33:36	20:24:00	5:46:24	1	Yes
83	506260	669699	1166	1	00:30:00	14:48:00	4:11:18	1	No
84	507292	670370	882	2	00:40:12	52:30:00	14:51:27	2, 3, 5	Yes
85	508206	670885	1026	3	00:00:00	00:00:00	0:00:00	-	No
86	506720	669853	815	1	00:42:00	52:00:00	14:42:58	1, 2, 4	Yes
87	507340	670366	845	2	00:42:00	57:36:00	16:18:03	2, 3, 5	Yes
88	508025	670503	736	2	00:54:00	72:36:00	20:32:45	2, 3, 6	Yes
89	509263	670401	870	6	00:58:48	83:12:00	23:32:44	3, 5, 6	Yes
90	509133	670426	791	3	01:05:24	93:30:00	26:27:38	2, 3, 5, 6	Yes

Building No.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Distance to Nearest Turbine (metres)	Nearest Turbine	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Giving Rise to Shadow Flicker Exceedance	Mitigation Strategy Required (for Potential Day Exceedance)?
91	508416	667476	717	9	00:00:00	00:00:00	0:00:00	-	No
92	509346	667917	705	10	00:33:00	48:36:00	13:45:14	7, 9	Yes
93	508930	671251	1398	3	00:00:00	00:00:00	0:00:00	-	No
94	507208	667332	1393	9	00:10:12	02:06:00	0:35:39	9	No
95	507331	667337	1294	9	00:00:00	00:00:00	0:00:00	-	No
96	507423	667356	1214	9	00:00:00	00:00:00	0:00:00	-	No
97	507452	667358	1191	9	00:00:00	00:00:00	0:00:00	-	No
98	507502	667354	1159	9	00:00:00	00:00:00	0:00:00	-	No
99	507548	667189	1254	9	00:00:00	00:00:00	0:00:00	-	No
100	508816	666916	1365	9	00:00:00	00:00:00	0:00:00	-	No

6.3.6.1.1 *Proposed Cahermurphy Two Wind Farm*

Of the 100 No. properties modelled, it is predicted that 54 No. properties may experience daily shadow flicker in excess of the DoEHLG guideline threshold of 30 minutes per day. This prediction is assuming worst-case conditions (i.e. 100% sunshine on all days where the shadow of the turbines passes over a house, wind blowing in the correct direction, no screening present, etc.) and in the absence of any turbine control measures. Of these 54 No. properties:

- 52 No. properties are occupied/vacant dwellings; and
- 2 No. properties are derelict dwellings

Of the 100 No. residential properties modelled, when the regional sunshine average (i.e. the mean amount of sunshine hours throughout the year) of 28.3%, the DoEHLG total annual guideline limit of 30 hours is predicted as being exceeded at five of the modelled properties.

It is worth nothing that in reality, the 'estimated actual' shadow flicker is considered conservative and likely to be significantly less than predicted in Table 6-1 as the following items are not considered by the model:

- Receivers may be screened by 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;
- At distances, greater than 500-1000m '*the rotor blade of a wind turbine will not appear to be chopping the light but the turbine will be regarded as an object with the sun behind it. Therefore, it is generally not necessary to consider shadow casting at such distances*'.

Section 6.4.3.1 outlines the mitigation strategies which will be employed at the potentially affected properties to ensure the daily shadow flicker threshold will not be exceeded.

6.3.6.2 Cumulative Shadow Flicker

For the assessment of cumulative shadow flicker, any other existing, permitted or proposed wind farms are considered where they are located within ten rotor diameters of the proposed turbines. In this case, a cumulative shadow flicker assessment was carried out to include both the permitted Cahermurphy Wind Farm (comprising 4 wind turbines 3 of which are constructed) and the proposed Cahermurphy Two Wind Farm. There were no other existing, permitted or proposed wind farms that were applicable. The permitted Cahermurphy Wind is located directly to the east of the proposed development (see Section 2.5 of Chapter 2 of this EIAR for further details).

Table 6-2 Maximum Potential Cumulative Daily and Annual Shadow Flicker

Building No.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Distance to Nearest Turbine (metres)	Nearest Turbine	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Giving Rise to Shadow Flicker Exceedance	Mitigation Strategy Required (for Potential Day Exceedance)?
1	509369	670139	670	11[1]	01:55:48	182:42:00	51:42:15	3, 5, 6, 12, 13, 14	Yes
2	509257	670291	767	6	01:04:48	103:42:00	29:20:50	3, 5, 6	Yes
3	509182	670334	774	3	01:09:00	109:42:00	31:02:42	2, 3, 5, 6	Yes
4	509020	670420	705	3	01:18:00	109:06:00	30:52:31	2, 3, 5, 6	Yes
5	509006	670480	741	3	01:06:00	83:48:00	23:42:55	2, 3, 5	Yes
6	509155	670491	851	3	00:55:48	71:18:00	20:10:40	3, 5, 6	Yes
7 (derelict)	508942	670546	756	3	01:02:24	69:24:00	19:38:25	2, 3	Yes
8	508817	671291	1408	3	00:00:00	00:00:00	00:00:00	-	No
9	508009	671016	1221	3	00:00:00	00:00:00	00:00:00	-	No
10	508188	670827	978	3	00:12:36	02:36:00	00:44:09	3	No
11	508432	671019	1112	3	00:00:00	00:00:00	00:00:00	-	No
12	509842	667929	1027	10	00:32:24	22:18:00	06:18:39	10	Yes

Building No.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Distance to Nearest Turbine (metres)	Nearest Turbine	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Giving Rise to Shadow Flicker Exceedance	Mitigation Strategy Required (for Potential Day Exceedance)?
13	510010	667945	1158	10	00:31:48	38:30:00	10:53:44	10	Yes
14 (derelict)	509849	667870	1069	10	00:21:36	08:54:00	02:31:07	10	No
15	509678	667839	964	10	00:00:00	00:00:00	00:00:00	-	No
16	509394	667682	936	10	00:27:36	11:36:00	03:16:58	9	No
17	509471	667575	1066	10	00:19:48	08:54:00	02:31:07	9	No
18	509382	667626	983	10	00:24:00	11:54:00	03:22:04	9	No
19	509244	667569	996	10	00:00:00	00:00:00	00:00:00	-	No
20	509338	667431	1154	10	00:00:00	00:00:00	00:00:00	-	No
21	509639	667356	1337	10	00:00:00	00:00:00	00:00:00	-	No
22	508905	667729	747	9	00:37:48	24:36:00	06:57:42	9	Yes
23	507564	668323	746	7	00:47:24	80:12:00	22:41:48	7, 9	Yes
24	507943	670573	802	2	00:48:36	56:48:00	16:04:28	3, 6	Yes
25	508042	670523	758	2	00:56:24	72:36:00	20:32:45	3, 6	Yes

Building No.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Distance to Nearest Turbine (metres)	Nearest Turbine	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Giving Rise to Shadow Flicker Exceedance	Mitigation Strategy Required (for Potential Day Exceedance)?
26	508016	670483	715	2	00:53:24	74:48:00	21:10:06	2, 3, 6	Yes
27	507960	670563	792	2	00:50:24	59:00:00	16:41:49	3, 6	Yes
28	508100	670495	725	3	01:21:36	95:54:00	27:08:23	1, 2, 3, 6	Yes
29	509696	668726	707	10	00:47:24	95:54:00	27:08:23	8, 10	Yes
30	509765	668730	775	10	00:43:12	74:06:00	20:58:13	8, 10	Yes
31	509804	668771	660	14[1]	00:41:24	63:54:00	18:05:01	8, 10	Yes
32	509838	668861	560	14[1]	00:40:12	71:54:00	20:20:52	6, 8, 10	Yes
33	509905	668819	570	14[1]	00:37:12	65:48:00	18:37:17	6, 8, 10	Yes
34	509961	668863	510	14[1]	00:35:24	71:42:00	20:17:28	6, 8, 10	Yes
35	510057	668847	490	14[1]	00:32:24	66:48:00	18:54:16	6, 8, 10	Yes
36	509579	667556	1133	10	00:00:00	00:00:00	00:00:00	-	No
37	508526	667475	742	9	00:00:00	00:00:00	00:00:00	-	No
38	508379	667449	739	9	00:00:00	00:00:00	00:00:00	-	No

Building No.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Distance to Nearest Turbine (metres)	Nearest Turbine	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Giving Rise to Shadow Flicker Exceedance	Mitigation Strategy Required (for Potential Day Exceedance)?
39	508559	667510	719	9	00:00:00	00:00:00	00:00:00	-	No
40	508702	667461	822	9	00:00:00	00:00:00	00:00:00	-	No
41	508973	667089	1279	9	00:00:00	00:00:00	00:00:00	-	No
42	509002	667115	1273	9	00:00:00	00:00:00	00:00:00	-	No
43	508298	667456	729	9	00:00:00	00:00:00	00:00:00	-	No
44	508275	667450	736	9	00:00:00	00:00:00	00:00:00	-	No
45	508204	667432	762	9	00:00:00	00:00:00	00:00:00	-	No
46	508117	667436	775	9	00:00:00	00:00:00	00:00:00	-	No
47	508162	667237	960	9	00:00:00	00:00:00	00:00:00	-	No
48	507578	667354	1108	9	00:00:00	00:00:00	00:00:00	-	No
49	507616	667411	1040	9	00:00:00	00:00:00	00:00:00	-	No
50	507712	667416	975	9	00:00:00	00:00:00	00:00:00	-	No
51	507762	667420	942	9	00:00:00	00:00:00	00:00:00	-	No

Building No.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Distance to Nearest Turbine (metres)	Nearest Turbine	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Giving Rise to Shadow Flicker Exceedance	Mitigation Strategy Required (for Potential Day Exceedance)?
52	507871	667414	888	9	00:00:00	00:00:00	00:00:00	-	No
53	507178	667859	1177	9	00:30:36	19:18:00	05:27:43	9	Yes
54	507181	667828	1182	9	00:30:36	20:00:00	05:39:36	9	Yes
55	507174	668003	1150	9	00:30:36	35:54:00	10:09:35	7, 9	Yes
56	507168	668123	1112	4	00:31:48	51:54:00	14:41:16	7, 9	Yes
57	507532	668235	779	9	00:43:12	53:06:00	15:01:38	7, 9	Yes
58 (derelict)	506984	668590	881	1	00:40:12	67:30:00	19:06:09	4, 7, 9	Yes
59	506900	668687	842	1	00:37:48	56:36:00	16:01:04	4, 7	Yes
60	506930	668696	817	1	00:39:00	63:24:00	17:56:32	4, 7	Yes
61	506920	668708	813	1	00:38:24	56:06:00	15:52:35	4, 7	Yes
62	506903	668759	782	1	00:37:48	46:12:00	13:04:29	4, 7	Yes
63	506827	668845	769	1	00:35:24	24:54:00	07:02:48	4	Yes
64	506824	668794	807	1	00:35:24	36:36:00	10:21:28	4, 7	Yes

Building No.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Distance to Nearest Turbine (metres)	Nearest Turbine	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Giving Rise to Shadow Flicker Exceedance	Mitigation Strategy Required (for Potential Day Exceedance)?
65 (school)	506168	668768	1356	1	00:27:36	30:06:00	08:31:06	1	No
66	506141	668759	1384	1	00:27:00	27:48:00	07:52:03	1	No
67	506204	668729	1343	1	00:28:12	31:54:00	09:01:40	1	No
68	506181	668729	1363	1	00:27:36	31:36:00	08:56:34	1	No
69	506235	668785	1289	1	00:28:48	34:06:00	09:39:01	1	No
70	506450	668783	1105	1	00:32:24	37:18:00	10:33:21	1, 4	Yes
71	506153	669205	1239	1	00:28:12	14:42:00	04:09:36	1	No
72	506302	669182	1096	1	00:31:48	19:24:00	05:29:25	1	Yes
73	506337	669172	1063	1	00:33:00	21:00:00	05:56:35	1	Yes
74	506376	669192	1022	1	00:34:12	22:24:00	06:20:21	1	Yes
75	506751	669073	700	1	01:07:12	107:42:00	30:28:45	1, 2, 4	Yes
76	506713	669161	703	1	01:16:12	114:06:00	32:17:25	1, 2, 4	Yes
77	506682	669253	711	1	01:09:00	81:00:00	22:55:23	1, 2, 4	Yes

Building No.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Distance to Nearest Turbine (metres)	Nearest Turbine	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Giving Rise to Shadow Flicker Exceedance	Mitigation Strategy Required (for Potential Day Exceedance)?
78	506534	669661	894	1	00:37:48	24:12:00	06:50:55	1	Yes
79	506490	669691	944	1	00:36:00	22:00:00	06:13:34	1	Yes
80	506478	669736	972	1	00:35:24	21:12:00	05:59:59	1	Yes
81	506473	669790	998	1	00:34:48	20:36:00	05:49:47	1	Yes
82	506475	669872	1033	1	00:33:36	20:24:00	05:46:24	1	Yes
83	506260	669699	1166	1	00:30:00	14:48:00	04:11:18	1	No
84	507292	670370	882	2	00:40:12	52:30:00	14:51:27	2, 3, 5	Yes
85	508206	670885	1026	3	00:00:00	00:00:00	00:00:00	-	No
86	506720	669853	815	1	00:42:00	52:00:00	14:42:58	1, 2, 4	Yes
87	507340	670366	845	2	00:42:00	57:36:00	16:18:03	2, 3, 5	Yes
88	508025	670503	736	2	00:54:00	72:36:00	20:32:45	2, 3, 6	Yes
89	509263	670401	870	6	00:58:48	83:12:00	23:32:44	3, 5, 6	Yes
90	509133	670426	791	3	01:05:24	93:30:00	26:27:38	2, 3, 5, 6	Yes

Building No.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Distance to Nearest Turbine (metres)	Nearest Turbine	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Giving Rise to Shadow Flicker Exceedance	Mitigation Strategy Required (for Potential Day Exceedance)?
91	508416	667476	717	9	00:00:00	00:00:00	00:00:00	-	No
92	509346	667917	705	10	00:33:00	48:36:00	13:45:14	7, 9	Yes
93	508930	671251	1398	3	00:00:00	00:00:00	00:00:00	-	No
94	507208	667332	1393	9	00:10:12	02:06:00	00:35:39	9	No
95	507331	667337	1294	9	00:00:00	00:00:00	00:00:00	-	No
96	507423	667356	1214	9	00:00:00	00:00:00	00:00:00	-	No
97	507452	667358	1191	9	00:00:00	00:00:00	00:00:00	-	No
98	507502	667354	1159	9	00:00:00	00:00:00	00:00:00	-	No
99	507548	667189	1254	9	00:00:00	00:00:00	00:00:00	-	No
100	508816	666916	1365	9	00:00:00	00:00:00	00:00:00	-	No

Notes
1. Turbine located at the permitted Cahermurphy Wind Farm site.

The cumulative model results (see Table 6-2) show that there are no additional properties where the guideline limits are exceeded due to cumulative shadow flicker from the proposed Cahermurphy Wind Farm Two in conjunction with the permitted Cahermurphy Wind Farm. However building no. 1 experiences an increase in potential shadow flicker due to the presence of both the permitted Cahermurphy Wind Farm and the proposed Cahermurphy Two Wind Farm. Section 6.4.3.1 outlines the mitigation strategies which will be employed at the potentially affected properties to ensure the daily shadow flicker threshold will not be exceeded for the houses in question.

6.4 Likely Significant Impacts and Associated Mitigation Measures

6.4.1 'Do-Nothing' Scenario

If the proposed development were not to proceed there would be no shadow flicker impacts other than the existing Cahermurphy Wind Farm project.

6.4.2 Construction Phase

6.4.2.1 Shadow Flicker

Shadow flicker, which occurs during certain conditions due to the movement of wind turbine blades, as described in this chapter of the EIAR, 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.

6.4.3 Operational Phase

The effects set out below relate to the operational phase of the proposed wind farm.

6.4.3.1 Shadow Flicker

Pre-Mitigation Impacts

Assuming worst-case conditions, a total of 54 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 predicted to be exceeded at 5 of the residential properties when the regional sunshine average of 28.3% is taken into account. Also, as described in detail above, there are a number of other additional reasons why this exceedance may not occur.

Proposed Mitigation Measures

In the event that shadow flicker exceedances are predicted to occur 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 hours per annum or 30 minutes per day at residential receptor locations post operation, 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 home owner 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 will 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.

The model will be re-run at the time of construction. Where exceedances are shown to occur at house locations in the vincity of the proposed wind farm, the windfarms SCADA system will be programmed to ensure limits are not exceeded.

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 proposed wind farm are anticipated to be capable of adhering to the requirements of the Draft Revised Wind Energy Development Guidelines 2019 should they be adopted 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. With the permission of the homeowner, the wind farm developer will log the date, time and duration of shadow flicker events occurring on at least five different days from within the dwelling. 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 have the potential to 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 an imperceptible 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.

6.4.4 Cumulative Effects

For the assessment of cumulative shadow flicker, any other existing, permitted or proposed wind farms are considered where they are located within ten rotor diameters of the proposed turbines. In this case, a cumulative shadow flicker assessment was carried out to include both the permitted Cahermurphy Wind Farm (comprising 4 wind turbines 3 of which are constructed) and the proposed Cahermurphy Two Wind Farm. There were no other existing, permitted or proposed wind farms that were applicable.

6.4.4.1 Shadow Flicker

As discussed in Section 6.3.6.2 above, the cumulative model results show that there are no additional properties where the guideline limits are exceeded due to cumulative shadow flicker from the proposed Cahermurphy Two Wind Farm in conjunction with the permitted Cahermurphy Wind Farm.

7. BIODIVERSITY

7.1 Introduction

7.1.1 Background

This chapter assesses the likely significant effects that the proposed development may have on Biodiversity, Flora and Fauna. The aim of the ecological impact assessment undertaken in this chapter is to ensure that elements of the proposed project that may potentially affect protected sites, habitats or species are adequately assessed. This assessment quantifies any potential effects relating to biodiversity, flora or fauna and identifies the design measures or mitigation required to avoid, reduce and mitigate likely significant effects. Where potential for effect was identified at an early stage in the project, alterations to the project layout have been incorporated. Where potential for residual effect remains, mitigation has been derived following a collaborative approach working with a multi-disciplinary team including project engineers, ecologists, hydrologists and hydrogeologists, and residual impacts on flora and fauna are assessed.

Particular attention has been paid to species and habitats of ecological importance. These include species and habitats with national and international protection under the Wildlife Acts 1976-2012 as amended EU Habitats Directive 92/43/EC and the EU Birds Directive 2009/147/EC among other relevant legislation (detailed assessment of birds is provided in Chapter 8: Biodiversity, Birds). 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 regarding 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 plans and projects are fully assessed.
- Proposed mitigation and best practice measures to ameliorate 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 potential for effects on birds is addressed separately, in Chapter 8 of this EIAR.

The following defined terms are utilised in this chapter:

- For the purpose of this EIAR, where the ‘proposed development site’ or ‘the site’ is referred to, this relates to the primary study area (wind farm site boundary) for the proposed development that includes the proposed grid connection route, as delineated in red in Figure 4-1 of the EIAR figures (maps) . “Development Footprint” refers to the construction envelope.

- "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 following best available guidance and adopting a precautionary approach.

7.1.2 Statement of Authority

Ecological baseline surveys, including bat surveys, were conducted by McCarthy Keville O'Sullivan (MKO) ecologists; Sarah Mullen (B.Sc., PhD), Pat Roberts (B.Sc., MCIEEM), Una Nealon (B.Sc., PhD), Laoise Kelly (B.Sc.), Olivia O'Gorman (B. Sc., M. Sc.), Julie O'Sullivan (B.Sc., M.Sc.), Claire Stephens (B.Sc.), Aoife Joyce (B.Sc., M.Sc.), Luke Dodebier (B.Sc.), Sara Fissolo (B.Sc.) and Irene Sullivan (B.Sc.) throughout 2018, 2019 and 2020. All surveyors have relevant academic qualifications and experience in undertaking habitat and ecological assessments.

This EIAR chapter has been prepared by Sarah Mullen (B.Sc., M.Sc., MCIEEM) and Pat Roberts (B.Sc., MCIEEM). Sarah has 4 years professional ecological consultancy experience. Pat is a highly experienced ecologist and has over 15 years' professional experience in environmental management and ecological assessment.

7.1.3 Relevant Guidance

The guidelines listed below 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, Coastal and Marine (CIEEM, 2018) (amended 2019).
- SNH (2019) 'Bats and onshore wind turbines: survey, Assessment and mitigation'
- Draft Revised guidelines on the information to be contained in Environmental Impact Statements (EPA, 2017).
- Draft Advice Notes for Preparing Environmental Impact Statements (EPA 2015)
- Guidelines for Planning Authorities and An Bord Pleanála on Carrying out Environmental Impact Assessment. Department of the Environment, Community and Local Government DoEHLG (2013).
- Environmental Impact Assessment of National Road Schemes –A Practical Guide (NRA, 2009).
- Guidelines for assessment of Ecological Impacts of National Road Schemes, (NRA, 2009).
- Environmental Assessment and Construction Guidelines (NRA, 2006).
- Advice Notes on Current Practice (in preparation of Environmental Impact Statements) (Environmental Protection Agency (EPA), 2003).
- Guidelines on the information to be contained in Environmental Impact Statements (EPA, 2002).
- European Commission Guidance on the preparation of the Environmental Impact Assessment Report (2017)
- Environmental Protection Agency (EPA) '*Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*' (August 2017)

7.2 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).

7.2.1 Desk Study

A comprehensive desk study was undertaken to inform this ecological impact assessment. This study included a thorough review of available information that is relevant to the ecology of the site of the proposed development. This information provides valuable existing data and also helps in assessing the requirement for additional ecological surveys.

The following list describes the sources of data consulted:

- Review of online web-mappers: National Parks and Wildlife Service (NPWS), Environmental Protection Agency (EPA)
- NPWS records (data request)
- Review of the Bat Conservation Ireland (BCI) Private Database
- Review of the publicly available National Biodiversity Data Centre web-mapper
- Records from the NPWS web-mapper and review of specially requested records from the NPWS Rare and Protected Species Database for the hectads which overlap with the proposed development site
- Inland Fisheries Ireland (IFI), Water Framework Directive River survey reports.

7.2.2 Scoping and Consultation

MKO undertook a scoping exercise during preparation of this EIAR, as described in Section 2.6 in Chapter 2 of this EIAR. Table 2-4, Chapter 2 of the EIAR, provides a list of the organisations consulted 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 7.1 provides a list of the organisations consulted with regard to biodiversity during the scoping process.

Table 7-1 Organisations consulted with regard to biodiversity

Consultee	Scoping Response Date	Scoping Response
An Taisce	None received.	No response
Bat Conservation Ireland	None received	No response
BirdWatch Ireland	05.06.2019	Acknowledgement of receipt.
Clare County Council – Planning Department	30.07.2019	Advised that the EIAR must include the information required under paragraph 1 of schedule 6 of the Planning and Development Regulations 2001, as amended and the Authority further advised cognisance is taken of the following: 1. Take into consideration the potential for impacts on water quality and substrate condition in the context of the presence of freshwater pearl mussels within

Consultee	Scoping Response Date	Scoping Response
		the Annageeragh and Creegh *Margaritifera* Sensitive Area; • This has been considered in the EIAR at Chapters 7 and 10. 2. All stages of the development should be considered in compiling information regarding the interaction of the development with surface water and groundwater. Impacts on downstream receptors shall be identified; • This has been considered in the EIAR at Chapters 7 and 10. 3. Given the concentration of windfarms within the area it is imperative that as part of the constraints study to inform the restrictions that 'avoidance of cumulative wind farm development' is given due consideration; • This has been considered in the EIAR at Chapters 3 and 13 4. The EIAR should take into account permitted dwellings that may not as yet be constructed; • This has been taken into account at Chapter 5 of the EIAR 5. A landslide susceptibility modelling exercise should be undertaken; • This has been considered at Chapter 9 of the EIAR and associated Appendix 6. Acoustics and vibration should be considered; • This has been considered at Chapter 12 of the EIAR 7. Noise should be assessed in the context of site preparation, ongoing operation and any restoration required; • This has been considered at Chapter 12 of the EIAR 8. The assessment of landscape and visual impacts will be critical given the concentration of windfarms surrounding the proposed site; • This has been considered at Chapter 13 of the EIAR 9. The Population and Human Health chapter should address the cumulative effect of such a high concentration of windfarms within this location; • This has been considered at Chapter 5 of the EIAR 10. The cumulative visual impact of an additional windfarm will need to take into consideration the degree of separation and similarity of design; • This has been considered at Chapter 13 of the EIAR 11. A description of 'reasonable alternatives' rather than an outline of main alternatives must be included. • This has been considered at Chapter 3 of the EIAR.

Consultee	Scoping Response Date	Scoping Response
Clare County Council – Environment Department	13.06.2019	Acknowledgement of receipt. A number of bodies have been notified of the request.
Clare County Council – Heritage Officer	13.06.2019	Acknowledgement of receipt. A number of bodies have been notified of the request.
Department of Agriculture, Food and the Marine	None received	No response
Department of Communications, Climate Action and the Environment	None received	No response
Department of Culture, Heritage and the Gaeltacht	26.06.2019 and 19.07.2019	Archaeology - the EIAR should contain a detailed cultural heritage section that addresses all built heritage within the footprint of the proposed windfarm. All assessments should be carried out by suitably qualified and suitably experienced archaeological personnel engaged by the client/contractor. The DAU also made the following observations: 1. Site is within the Annageragh & Creegh River Freshwater Pearl Mussel catchments. 2. There are records of Hen Harrier breeding in the site. 3. The site contains suitable habitat for Curlew and Marsh Fritillary Butterfly. 4. The site contains peatland habitats, some of which may be Annex habitat. • Please refer to Chapter 14 of the EIAR, Cultural Heritage
Inland Fisheries Ireland	None received	No response
Irish Peatland Conservation Council	None received.	No response.
Irish Red Grouse Association	None received	No response
Irish Raptor Study Group	None received	Requested not to be included in future scoping exercises.

Consultee	Scoping Response Date	Scoping Response
Irish Water	None received	No response
Irish Wildlife Trust	None received	No response
The Heritage Council	None received	No response

7.2.3 Field Surveys

A comprehensive survey of the biodiversity of the entire proposed development site including the grid connection route options was undertaken on various dates throughout 2018, 2019 and 2020. The following sections fully describe the ecological surveys that have been undertaken and provide details of the methodologies, dates of survey and guidance followed.

7.2.3.1 Multi-disciplinary ecological walkover surveys

Multi-disciplinary ecological walkover surveys were undertaken in accordance with NRA Guidelines on Ecological Surveying Techniques for Protected Flora and Fauna on National Road Schemes (NRA, 2009). This survey provided baseline data on the ecology of the proposed development site and assessed whether further, more detailed habitat or species specific ecological surveys were required. The multi-disciplinary ecological walkover survey comprehensively covered the area of the proposed wind farm development site, including turbine bases, hard standing areas, proposed substations, site compound, new internal roads and borrow pit. The multi-disciplinary ecological walkover survey also included the proposed grid connection route options.

Habitats were classified in accordance with the Heritage Council's 'Guide to Habitats in Ireland' (Fossitt, 2000). Habitat mapping was undertaken with regard to guidance set out in 'Best Practice Guidance for Habitat Survey and Mapping' (Smith et al., 2011).

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).

The walkover surveys were designed to detect the presence, or suitable habitat for a range of protected faunal species that may occur in the vicinity of the proposed development.

During the multidisciplinary surveys, a search for Invasive Alien Species (IAS), with a focus on those listed under the Third Schedule of the European Communities Regulations 2011 (S.I. 477 of 2011), was also conducted.

The walkover surveys were undertaken on 8th and 9th May 2019, 19th July 2019, 27th August 2019, 4th September 2019 and 11th October 2019 and 14th of May 2020. The majority of the survey timing falls within the recognised optimum period for vegetation surveys/habitat mapping, i.e. April to September (Smith et al., 2011). Surveys undertaken outside of this period were not used to evaluate habitats. A comprehensive walkover of the entire EIAR primary study area was completed.

7.2.3.2 Detailed Habitat Assessment

7.2.3.2.1 *Turbine Base and Infrastructure Locations*

Detailed habitat assessments were undertaken at the location of all turbine bases as well as in habitats within the development footprint which were considered likely to correspond to EU Habitats Directive Annex I habitat types. A 2m x 2m relevé was taken at each turbine location/likely Annex I habitat site within the construction footprint. All plant species within the 2m x 2m relevé were recorded and cover/abundance values for each species were recored. A copy of the relevé data is included in the Turbine Base Botanical Study in Appendix 7-1 of this EIAR.

Habitats likely to correspond to EU Habitats Directive Annex I habitat types have been described and assessed in accordance with NPWS guidance from the relevant national Annex I habitat surveys/ Irish Wildlife Manuals.

The habitat assessment surveys described in this report, including EU Habitats Directive Annex I classification and condition assessment, have been undertaken with reference to the following guidelines and interpretation documents:

- 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. Natioal Parks and Wildlife service, 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 & 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
- Commission of the European Communities (2007) Interpretation manual of European Union habitats. Eur 27. European Commission DG Environment.

7.2.3.3 Faunal Surveys

The results of the desk study, scoping replies and multidisciplinary walkover surveys were utilised to inform the scope of targeted ecological surveys required.

In terms of mammals, dedicated surveys for otter (*Lutra lutra*), badger (*Meles meles*) and bats were undertaken. Following the completion of ecological walkover surveys, no requirement for further dedicated mammal surveys was identified. The non-volant mammal surveys covered the entire EIAR development site, including the proposed grid connection route.

During the multidisciplinary walkover surveys, records of invertebrates including butterflies, damselflies, dragonflies, bees etc. were also recorded. As the desk study identified records for marsh fritillary (*Euphydryas aurinia*) from the 10km grid squares overlapping the development, this species was also focused on during the site visits with dedicated surveys undertaken in August and September 2019 in areas of suitable habitat to determine the occurrence, distribution and likely size of the population within the development site.

Aquatic faunal surveys were also undertaken. Freshwater invertebrate kick sampling surveys and habitat suitability assessments for freshwater pearl mussel (*Margaritifera margaritifera*) were undertaken at locations downstream of the development site in October 2019 and are described below.

7.2.3.3.1 Otter Survey

Areas identified during the multidisciplinary walkover survey as providing potential habitat for otter were subject to specialist targeted survey. The otter surveys of watercourses were conducted on 8th & 9th May (grid connection route), 19th July 2019, 27th August 2019 and 4th September 2019 by Sarah Mullen (B.Sc., Ph.D.), the 11th October 2019 by Sarah Mullen and Pat Roberts (B.Sc., MCIEEM) and 14th May 2020 by Olivia O'Gorman (B. Sc., M. Sc.).

The otter surveys were 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'.

7.2.3.3.2 Badger Survey

Areas within the development site identified as providing potential habitat for badger were subject to a targeted badger survey. Dedicated badger surveys were undertaken on 8th & 9th May 2019 (grid connection routes), 19th July 2019 and 27th August 2019 by Sarah Mullen (B.Sc., PhD).

The badger surveys were conducted in order to determine the presence or absence of badger signs within the proposed development site. 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 was cognisant of the 'Guidelines for the Treatment of Badger Prior to the Construction of National Roads Schemes' (NRA, 2006a).

7.2.3.3.3 Bat Surveys

Bat surveys were undertaken throughout 2018 and 2019 and were designed in accordance with the Bat Conservation Trust's guidelines for wind turbine developments (Hundt, 2012) and Scottish Natural Heritage's guidance for bats and onshore wind turbines (SNH, 2019). Bat surveys employed a combination of methods, including desktop study, habitat and landscape assessments, roost inspections, manual activity surveys and static detector surveys at ground level and at height. Details of the bats surveys undertaken are described in full in a separate bat report which was prepared for the proposed development and is included as Appendix 7-2 of this EIAR.

7.2.3.3.4 Freshwater Pearl Mussel Survey

The proposed windfarm is located within two hydrological catchments where Freshwater Pearl Mussel (*Margaritifera margaritifera*) are present. These are the Annageeragh catchment and the Creegh catchment. In recent surveys undertaken by Clare County Council, low numbers of freshwater pearl mussel were recorded in the Annageeragh River and the species was considered to be functionally extinct in the Creegh River.

Assessments of the watercourses within the development site for suitability for freshwater pearl mussel (*Margaritifera margaritifera*) were undertaken on the 11th October 2019 by Pat Roberts (B.Sc., MCIEEM). Dedicated habitat suitability assessments for freshwater pearl mussel were also undertaken outside and downstream of the proposed development site at each of the streams that flow off the site in both the Annageeragh and Creegh catchments. These assessments were undertaken to determine whether there was any suitable habitat or potential for populations to be present in close proximity downstream of the wind farm development site. The survey locations are provided on Figure 7.1

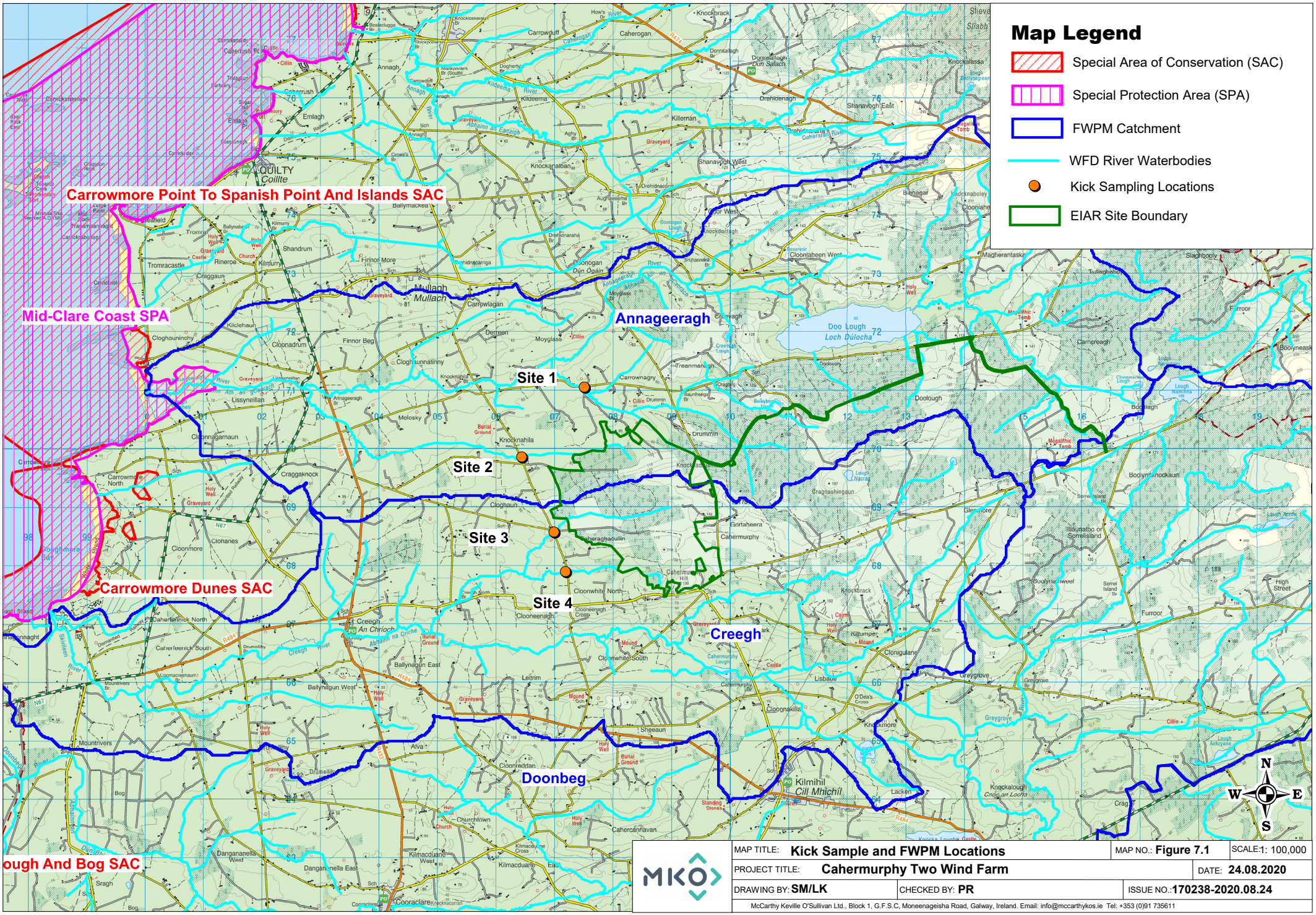
The surveys were conducted, in accordance with the *Margaritifera* Stage 1 and Stage 2 Survey Guidelines produced by the NPWS (Irish Wildlife Manual No. 12), by a suitably qualified ecologist under license number C93/2019 from the NPWS. A copy of the license is provided as Appendix 7-3 to this report.

7.2.3.3.5 Freshwater Invertebrate Survey

Invertebrate kick sampling surveys of watercourses downstream of the development site were undertaken on the 11th October 2019 by Pat Roberts (B.Sc., MCIEEM) and Sarah Mullen (B.Sc., PhD) in order to provide a baseline against which water quality in the watercourses downstream of the site can be monitored throughout construction and operation. Kick sampling was carried out downstream of the proposed development site at the same four locations at which habitat suitability assessments for freshwater pearl mussel (described above) were undertaken. The survey locations are provided on Figure 7.1

7.2.3.3.6 Marsh Fritillary Surveys

Areas identified during the multidisciplinary walkover survey as providing potential habitat for marsh fritillary were subject to specialist targeted survey. Dedicated surveys for marsh fritillary larval webs were undertaken in areas of suitable habitat throughout the proposed development site to determine the occurrence, distribution and likely size of the population within the development site. These surveys were undertaken on the 27th August 2019 and 4th September 2019. The survey methodology followed that described in the NRA (2009) best practice guidance document.



MAP TITLE: **Kick Sample and FWPM Locations**		MAP NO.: **Figure 7.1**	SCALE:1: 100,000
PROJECT TITLE: **Cahermurphy Two Wind Farm**			DATE: **24.08.2020**
DRAWING BY: **SM/LK**	CHECKED BY: **PR**		ISSUE NO.:**170238-2020.08.24**

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7.2.4 Methodology for Assessment of Impacts and Effects

7.2.4.1 Determining Importance of Ecological Receptors

The importance of the ecological features identified within the proposed development site 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 Local Importance (Higher Value), County, National or International importance 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.

7.2.4.2 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). 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 result 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** 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.

7.2.4.3 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 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 Statements (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 7.2 below.

Table 7-2 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.

Effect Magnitude	Definition
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).

7.2.4.4 Incorporation of Mitigation

The development footprint has been designed to specifically avoid, reduce and minimise effects on all KERs. Section 7.5 of this chapter assesses the potential impacts of the proposal to ensure that all impacts on Key Ecological Receptors (KERs) are adequately addressed. Where significant impacts on KERs are predicted, mitigation has been incorporated into the project design or layout to address such impacts. The implemented mitigation measures aim to result in no significant residual impacts post mitigation. 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 KERs. The potential effects of the proposed development site were considered and assessed to ensure that all effects on KERs are adequately addressed and no significant residual effects are likely to remain following the implementation of mitigation measures / best practice.

7.2.4.5 Limitations

The information provided in this EIAR chapter accurately and comprehensively describes the baseline ecological environment; 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.

7.3 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 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.

7.3.1 Designated Sites

The potential for the proposed development to impact on sites that are designated for nature conservation was considered in this Ecological Impact Assessment.

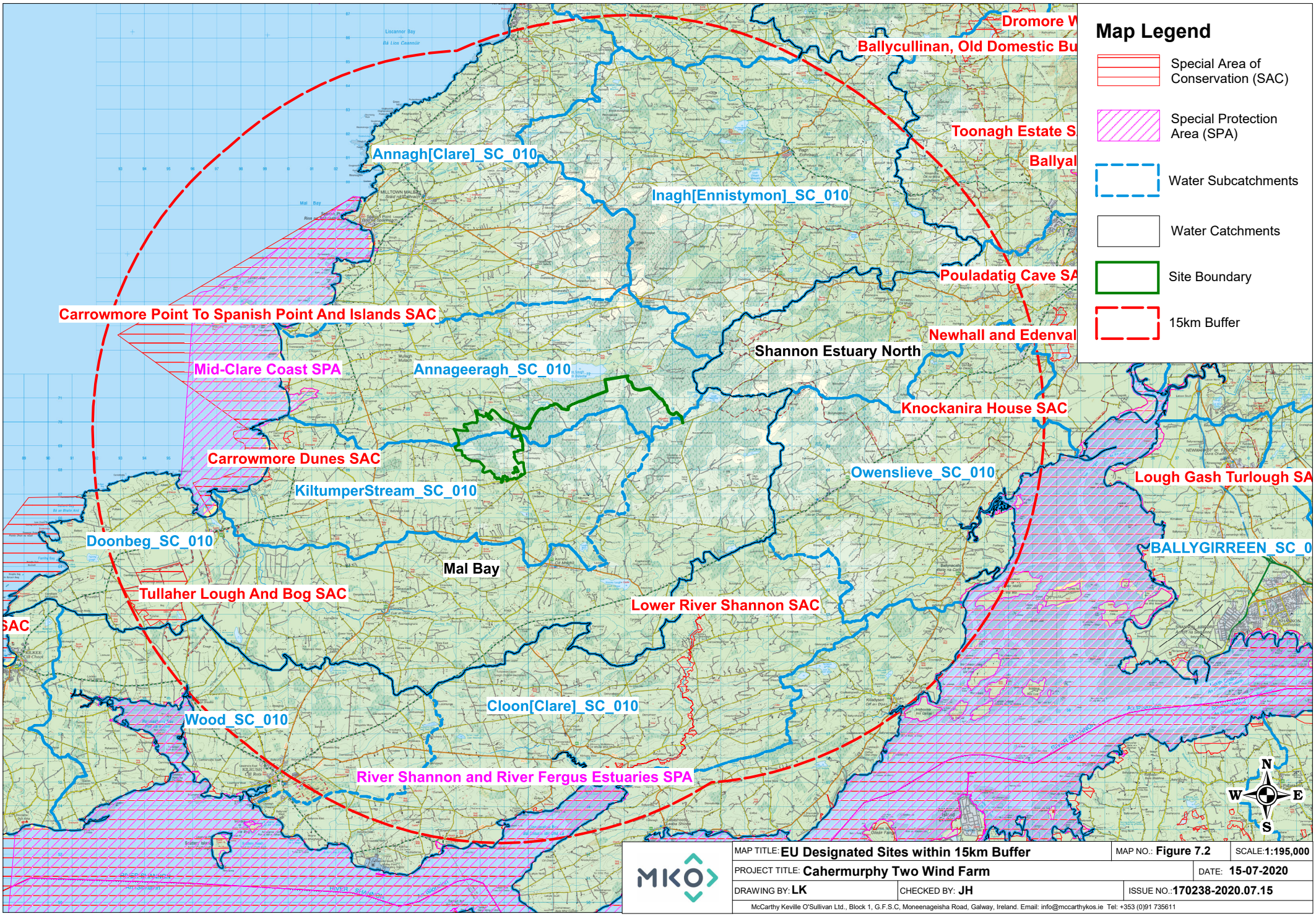
Special Areas of Conservation (SACs) and Special Protection Areas for Birds (SPAs) are designated under EU Habitats Directive and are collectively known as ‘European Sites’. The potential for effects on European Sites is fully considered in the Natura Impact Statement that accompanies this application and discussed also in this chapter of the EIAR.

Natural Heritage Areas (NHAs) are designated under 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 chapter of the EIAR.

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 designated sites and water catchments were downloaded from the NPWS website (www.npws.ie) and the EPA website (www.epa.ie) on the 20/08/2020. The datasets were utilized 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 Sites at distances of greater than 15km from the proposed development was also considered in this initial assessment. In this case, no potential connectivity with sites located at a distance of over 15km from the proposed development was identified.
- A map of all the European Sites within 15km is provided in Figure 7.2. All other designated sites within 15km are shown in Figure 7.3.
- Catchment mapping was used to establish or discount potential hydrological connectivity between the site of the proposed development and any Designated Sites. The hydrological catchments are also shown in Figures 7.2 & 7.3.
- In relation to Special Protection Areas, in the absence of any specific European or Irish guidance in relation to such sites, 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 species may travel beyond the boundary of their SPAs and provides information on dispersal and foraging ranges of bird species which are frequently encountered when considering plans and projects.
- Table 7.3, provides details of all relevant Designated Sites as identified in the preceding steps and assesses which are within the likely Zone of Impact.
- The site synopses and conservation objectives of these sites, as per the NPWS website (www.npws.ie), were consulted and reviewed at the time of preparing this report 20/08/2020. Figures 7.2 and 7.3 show the location of the proposed development in relation to all European sites within 15km of the proposed development. Where potential pathways for Significant Effect are identified, the site is included within the Likely Zone of Impact and further assessment is required.



MAP TITLE: **EU Designated Sites within 15km Buffer**		MAP NO.: **Figure 7.2**	SCALE: **1:195,000**
PROJECT TITLE: **Cahermurphy Two Wind Farm**			DATE: **15-07-2020**
DRAWING BY: **LK**	CHECKED BY: **JH**		ISSUE NO.: **170238-2020.07.15**

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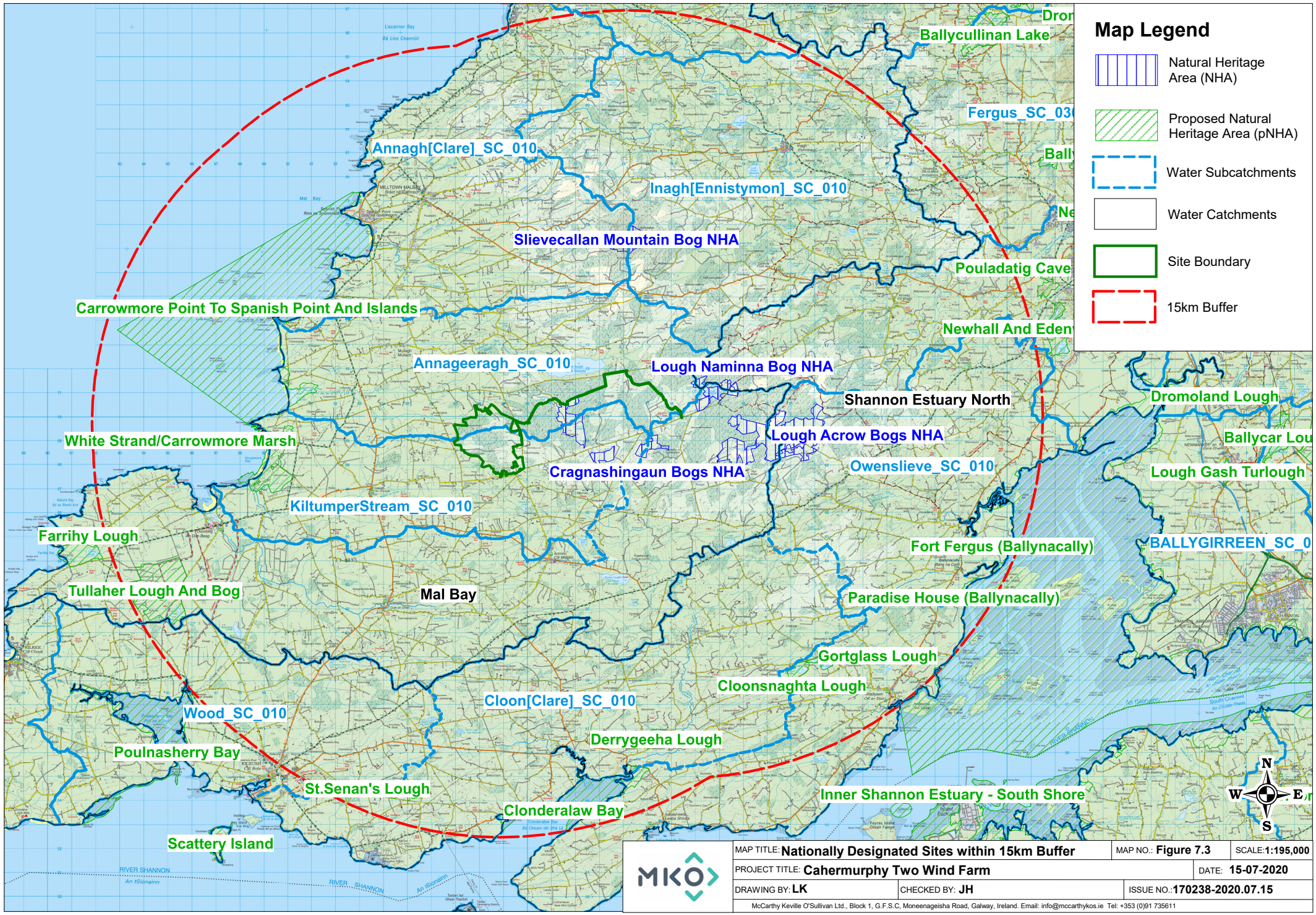

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MAP TITLE: **Nationally Designated Sites within 15km Buffer**		MAP NO.: **Figure 7.3**	SCALE: **1:195,000**
PROJECT TITLE: **Cahermurphy Two Wind Farm**			DATE: **15-07-2020**
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Table 7-3 Designated Sites within the Likely Zone of Impact

Designated Site	Distance from Proposed Development (km)	Likely Zone of Impact Determination
Special Areas of Conservation (SAC)		
Carrowmore Point to Spanish Point and Islands SAC (001021)	5.8 km	Potential for impact on • Carrowmore Point to Spanish Point and Islands SAC • Carrowmore Dunes SAC was identified in the AASR and are assessed in full in the Natura Impact Statement.
Carrowmore Dunes SAC (002250)	6.6km	
Lower River Shannon SAC (002165)	7.9km	The following SACs were not identified as occurring within the Likely Zone of Impact: • Lower River Shannon SAC • Tullaher Lough and Bog SAC • Knockanira House SAC Pouladatig Cave SAC
Tullaher Lough and Bog SAC (002343)	12.4km	
Knockanira House SAC (002318)	12.5km	
Pouladatig Cave SAC (000037)	14.9 km	
Special Protection Area (SPA)		
Mid-Clare Coast SPA (004182)	5.8km	Potential for significant effects on: • Mid-Clare Coast SPA was identified in the AASR and is assessed in full in the Natura Impact Statement.
River Shannon and River Fergus Estuaries SPA (004077)	12.3km	The following SPA was not identified as occurring within the Likely Zone of Impact: • River Shannon and River Fergus Estuaries SPA
Natural Heritage Area (NHA)		
Cragnashingaun Bogs NHA	1.6km from the wind farm site	There is no potential for the wind farm development itself to result in impacts on this NHA as there is no potential pathway for effect on this terrestrial habitat that is located 1.6km from the works. The proposed cable route runs adjacent to the northern boundary of this NHA. However the cable route runs along the edge of forestry

Designated Site	Distance from Proposed Development (km)	Likely Zone of Impact Determination
	Adjacent to proposed grid connection route	plantation and does not encroach on peatland habitat and will not result in significant drainage impacts on the wider area. There is no potential pathway for direct or indirect impacts on the NHA as a result of the proposed development. No requirement for further assessment.
Lough Namina Bog NHA	7.4km from the wind farm site 0.7km from proposed grid connection route	There is no surface water connectivity between the proposed development site and the NHA and the NHA is located upgradient of the propsoed development. There is no potential for impacts on this site. No requirement for further assessment.
Lough Acrow Bogs NHA	8.0km 1.9km from proposed grid connection route	There is no surface water connectivity between the proposed development site and the NHA and the NHA is located upgradient of the propsoed development. There is no potential for impacts on this site. No requirement for further assessment.
Slievecallan Mountain Bog NHA	8.4km from the wind farm site. 4.9km from proposed grid connection route	There is no surface water connectivity between the proposed development site and the NHA. There is no potential for impacts on this site. No requirement for further assessment.
Proposed Natural Heritage Area pNHA)		
Carrowmore Point to Spanish Point and Islands	5.8km	There is surface water connectivity between the proposed development and this site. This site is considered to be within the Likely Zone of Impact and further assessment is required. This designated site is contiguous with the Carrowmore Point to Spanish Point and Islands SAC (001021) and impacts are assessed in relation to the SAC designation.
White strand / Carrowmore Marsh	6.6km	There is surface water connectivity between the proposed development and this site. This site is considered to be within the Likely Zone of Impact and further assessment is required.

Designated Site	Distance from Proposed Development (km)	Likely Zone of Impact Determination
Cloonsnaghta Lough	11.3km	There is no surface water connectivity between the proposed development site and the pNHA. There is no potential for impacts on this site. No requirement for further assessment.
Gortglass Lough	11.4km	There is no surface water connectivity between the proposed development site and the pNHA. There is no potential for impacts on this site. No requirement for further assessment.
Derrygeeha Lough	12.1km	There is no surface water connectivity between the proposed development site and the pNHA. There is no potential for impacts on this site. No requirement for further assessment.
Tullaher Lough and Bog	12.4km	There is no surface water connectivity between the proposed development site and the pNHA. There is no potential for impacts on this site. No requirement for further assessment.
Fergus Estuary and Inner Shannon, North Shore	12.6km	There is no surface water connectivity between the proposed development site and the pNHA. There is no potential for impacts on this site. No requirement for further assessment.
Clonderalaw Bay	12.9km	There is no surface water connectivity between the proposed development site and the pNHA. There is no potential for impacts on this site. No requirement for further assessment
St. Senan's Lough	13.5km	There is no surface water connectivity between the proposed development site and the pNHA. There is no potential for impacts on this site. No requirement for further assessment.
Paradise House (Ballynacally)	13.5km	There is no surface water connectivity between the proposed development site and the pNHA. There is no potential for impacts on this site. No requirement for further assessment.
Fort Fergus (Ballynacally)	14.3km	There is no surface water connectivity between the proposed development site and the pNHA. There is no potential for impacts on this site. No requirement for further assessment.
Poulnasherry Bay	14.9km	There is no surface water connectivity between the proposed development site and the pNHA. There is no potential for impacts on this site. No requirement for further assessment.

7.3.1.1 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 was carried out as part of this assessment (reviewed 15.07.2020).

In a search of the NPWS Article 17 datasets, no mapped Annex I habitats were found within the site. An area of Blanket Bog [7130] occurs adjacent ot the grid connection route and is designated part of Cragnashingaun Bog NHA. The grid connection route occurs within forestly track at this location and will not impact on this Annex I habitat within the NHA. Approximately 714m to the south of this is an area of Dry Heath [4030] and 864m south of the grid connection route is an area of Transition Mire and Quaking Bog [7140]. These additional peatland habitas are also located within the Cragnashingaun Bog NHA boundary. These habiats will not be impacted by the proposed works. The location of these habitats is shown in Figure 7.4.

7.3.2 New Flora Atlas

A search was made in the New Atlas of the British & Irish Flora (Preston et al., 2002) to investigate whether any rare or unusual plant species listed as Annex II of the Habitats Directive which are listed as rare on the Red Data List (Curtis and McGough 1988) or protected under the Flora (Protection) Order, 1999 had been recorded in the relevant 10km squares in which the study site is situated (R06 and R07), during the 1987-1999 atlas survey as shown in Table 7.4.

Table 7-4 Records of species listed under the Flora Protection Order 2015 or the Irish Red Data Book for Vascular Plants

Common Name	Scientific Name	Status
Large-flowered hemp nettle	*Galeopsis speciosa*	NT (Near Threatened)
Dwarf mallow	*Malva neglecta*	NT (Near Threatened)
Corky-fruited water-dropwort	*Oenanthe pimpinelloides*	NT (Near Threatened)

7.3.2.1 Bryophytes

A search of the NPWS online data map for bryophytes (accessed 30/10/2019) was also undertaken with no protected bryophytes recorded within or adjacent to the proposal.

7.3.3 NPWS Records

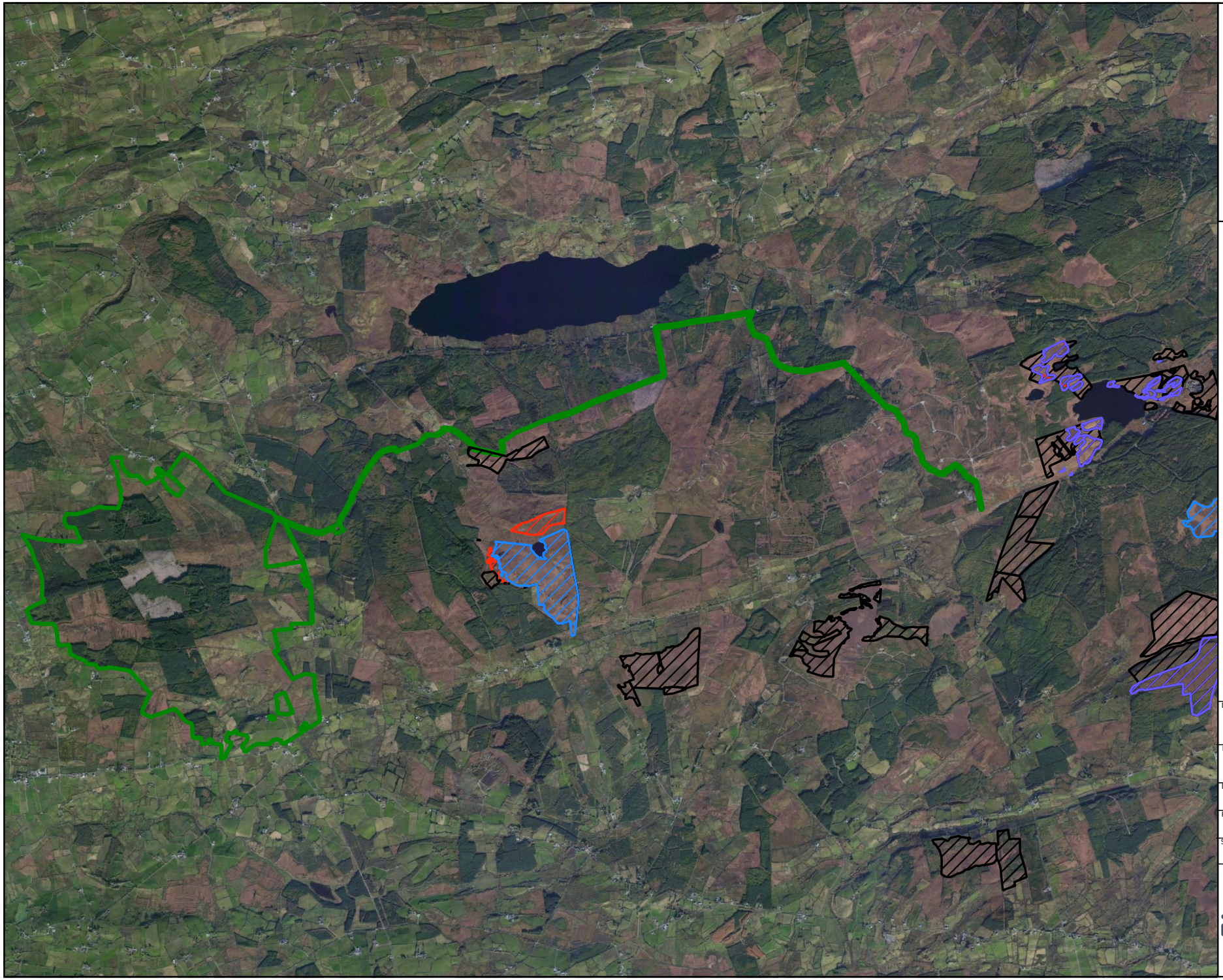
NPWS online records were searched on 30th October 2019 to provide data for records of any rare or protected species of flora or fauna within a 5km radius of the proposed development which encompasses the 10 kilometre grid squares R06, R07, R16 and R17. A data request was also sent to the NPWS and data received in relation to the grid square R06, R07, R16 and R17 on the 21st March 2019. Table 7-55 lists the rare and protected species records obtained from the NPWS during this study.

Table 7-5 Records for rare and protected species, NPWS.

Common Name	Scientific Name	Status
Otter	*Lutra lutra*	Annex II, Annex IV

Common Name	Scientific Name	Status
Common frog	*Rana temporaria*	Annex V
Common lizard	*Lacerta vivipara*	WA
Narrow-mouthed whorl-snail	*Vertigo angustior*	Annex II
Lichen	*Cladonia ciliata*	Annex V
Reindeer moss	*Cladonia portentosa*	Annex V

Annex II, Annex IV, Annex V – of EU Habitats Directive, WA – Irish Wildlife Acts (1976-2017), Red Data List (Curtis and McGough 1988), BoCCI Red List – Birds of Conservation Concern in Ireland (Population for which the species is red listed in brackets), AEWA -Agreement on the Conservation of African-Eurasian Migratory Waterbirds [1999].



Drawing Title

NPWS Article 17 Habitats

Project Title

Cahermurphy Two Wind Farm

Drawn By	Checked By
LK	JH
Project No.	Drawing No.
170238	Figure 7.4
Scale	Date
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7.3.4 Biodiversity Ireland Database

A search of the National Biodiversity Data Centre (NBDC) website was conducted prior to the commencement of site surveys. This helped to inform survey effort and provide a baseline of likely species composition in the area. The National Biodiversity Data centre database was accessed again on 30/10/2019 and the following information was obtained. Table 7.6 lists the protected faunal species (excluding birds which are dealt with in Chapter 8 of this EIAR) recorded within the hectad which pertains to the current development site. The database was also searched for records of Third Schedule non-native invasive species within the hectad. Table 7-77 lists the non-native invasive species recorded within the hectad.

Table 7-6 NBDC records for protected fauna records (excl. birds).

Common Name	Scientific Name	Status	Hectad
Large white-moss	*Leucobryum glaucum*	HD Annex IV	R06, R16, R17
Common frog	*Rana temporaria*	HD Annex V, WA	R06, R07, R16, R17
Common lizard	*Zootoca vivipara*	WA	R17
Daubenton's bat	*Myotis daubentonii*	HD Annex IV, WA	R06, R16
Lesser noctule	*Nyctalus leisleri*	HD Annex IV, WA	R06, R16, R17
Common pipistrelle	*Pipistrelle (Pipistrellus sensu lato)*	HD Annex IV, WA	R06, R07, R16, R17
Soprano pipistrelle	*Pipistrellus pygmaeus*	HD Annex IV, WA	R06, R16, R17
Brown long-eared bat	*Plecotus auritus*	HD Annex IV, WA	R16, R17
Natterer's bat	*Myotis nattereri*	Annex IV, WA	R17
Otter	*Lutra*	HD Annex II, IV, WA	R06, R07, R16, R17
Pine marten	*Martes*	HD Annex V, WA	R07, R16, R17
Badger	*Meles meles*	WA	R06, R07, R16, R17
Fallow deer	*Dama dama*	WA	R16, R17
Red squirrel	*Sciurus vulgaris*	WA	R16
Irish hare	*Lepus timidus*	WA	R06, R16
Hedgehog	*Erinaceus europaeus*	WA	R06, R07, R16
Narrow-mouthed whorl snail	*Vertigo angustior*	HD Annex II, WA	R07
Marsh fritillary	*Euphydryas aurinia*	HD Annex II	R16, R17
Loggerhead turtle	*Caretta caretta*	HD Annex II, IV, WA	R07

Common Name	Scientific Name	Status	Hectad
Leathery turtle	*Dermochelys coriacea*	HD Annex IV, WA	R07
Bottle-nosed dolphin	*Tursiops truncates*	HD Annex II, IV, WA	R06, R07
Common dolphin	*Delphinus delphis*	HD Annex IV, WA	R07
Common porpoise	*Phocoena phocoena*	HD Annex II, IV, WA	R07
Cuvier's Beaked Whale	*Ziphius cavirostris*	HD Annex IV, WA	R07
Long-finned pilot whale	*Globicephala melas*	HD Annex IV, WA	R07
Sowerby's beaked whale	*Mesoplodon bidens*	HD Annex IV, WA	R07
Sperm whale	*Physeter macrocephalus*	HD Annex IV, WA	R07
Striped dolphin	*Stenella coeruleoalba*	HD Annex IV, WA	R07

Annex II, Annex IV, Annex V – Of EU Habitats Directive, WA – Irish Wildlife Acts (1976-2017).

Table 7-7 NBDC records for Invasive species.

Common Name	Scientific Name	Hectad
Japanese knotweed	*Fallopia japonica*	R06, R07, R16
Himalayan knotweed	*Persicaria wallichii*	R07, R17
Rhododendron	*Rhododendron ponticum*	R07, R16, R17
Spanish Bluebell	*Hyacinthoides hispanica*	R07
Himalayan balsam	*Impatiens glandulifera*	R16
American mink	*Mustela vison*	R06
Zebra mussel	*Dreissena (Dreissena) polymorpha)*	R17

7.3.4.1 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: E108565 N168915). The search yielded no records of roosts within a 1km radius of the proposed development. The search was extended to include a 10km radius including roosts, transects and ad-hoc observations. A number of ad-hoc observations (n=10) have been recorded. At least six of Ireland's nine resident bat species were recorded within 10 km of the proposed works including common and soprano pipistrelle, Leisler's bat, Daubenton's bat, Natterer's bat, Myotis sp. and brown long-eared bat, as well as several records of unidentified bats. Details of the results are provided in Table 7.8 below.

Table 7-8 Bat Records within 1 and 10 km of proposed development

Type	Location	Results	Survey	Designation
Ad-Hoc	Co. Clare	Species: Myotis sp., Pipistrellus pygmaeus	BATLAS 2010	Annex IV
	Knocka Lough and castle Clare	Species: Myotis daubentonii, Nyctalus leisleri, Pipistrellus pipistrellus (45kHz), Pipistrellus pygmaeus	BATLAS 2010	Annex IV
	Cooraclare area, Co. Clare	Species: Pipistrellus pygmaeus	BATLAS 2010	Annex IV
	Cooraclaire Clare	Species: Myotis daubentonii, Nyctalus leisleri, Pipistrellus pipistrellus (45kHz), Pipistrellus pygmaeus	BATLAS 2010	Annex IV
	Bealaclugga Bridge, N67 Spanish Point, Co. Clare	Species: Pipistrellus pipistrellus (45kHz)	EIS surveys - Brian Keeley	Annex IV
	Clohanbeg, Co. Clare	Species: Myotis natterreri, Myotis sp., Nyctalus leisleri, Pipistrellus pipistrellus (45kHz), Pipistrellus pygmaeus, Plecotus auritus, Unidentified bat	McCarthy Keville OSullivan Bat Surveys	Annex IV
	Co. Clare	Species: Myotis sp., Pipistrellus pipistrellus (45kHz), Pipistrellus pygmaeus, Pipistrellus sp. (45kHz/55kHz), Plecotus auritus	McCarthy Keville OSullivan Bat Surveys	Annex IV
	Knockalassa, Co. Clare	Species: Pipistrellus pipistrellus (45kHz), Pipistrellus pygmaeus, Unidentified bat	McCarthy Keville OSullivan Bat Surveys	Annex IV
	Boolynamweel, Co. Clare	Species: Pipistrellus pygmaeus, Pipistrellus sp. (45kHz/55kHz)	McCarthy Keville OSullivan Bat Surveys	Annex IV
	Co. Clare	Species: Myotis natterreri, Myotis sp., Pipistrellus pipistrellus (45kHz), Pipistrellus pygmaeus, Pipistrellus sp. (45kHz/55kHz), Plecotus auritus, Unidentified bat	McCarthy Keville OSullivan Bat Surveys	Annex IV

7.3.5 Water Quality

7.3.5.1 EPA Water Quality Data

The EPA web-mapper (https://gis.epa.ie/EPAMaps/) was consulted on the 14/07/2020 to provide data regarding the water quality and status of waterbodies that are located downstream of the site of the proposed development.

The wind farm development site is situated within the Mal Bay catchment and drains to the catchment via the Lissyneillan stream, Knocknahila_Beg and Koncknahila More streams and the Clooneenagh streams. The northern section of the site drains towards the Annageeragh River via the Knocknahilla Beg Stream (EPA code: 28K16) and the Lissyneillan Stream (EPA code: 28L10). The Anageeragh River discharges into the Annageeragh River Estuary, north of Doughmore (~9.7km downstream of the site). The southern section of the site drains to the Creegh River via Knocknahila More stream (EPA code: 28K15) and the Clooneenagh stream (EPA code: 28C08). The Creegh River discharges into the Creegh river Estuary at Doughmore Bay.

There are no Environmental Protection Agency (EPA) Q-value monitoring sites within the proposal boundary or immediately downstream. Sample station ID RRS28A020200 (ANNAGEERAGH – Knocknahila Bridge) on the Annageeragh River is located 3.7km downstream of the proposal via the

Knocknahila Beg stream. The latest Q-Value at this location has been recorded as "Q4 - Good". Sample station RS28C081100, within the Clooneenagh Stream is located 2.8km downstream of the proposal via the Knocknahila More stream. The latest Q-Value at this location has been recorded as "Q4 - Good". The EPA sampling station results provide a baseline against which any water quality changes occurring in the future can be measured.

The WFD River Waterbody Status 2013-2018 for the Annageeragh River downstream of the site via both the Knocknahila More Stream and the Lissyneillan Stream, has been assessed as having "good" quality status. The river has been assessed as being "not at risk".

The WFD River Waterbody Status 2013-2018 for the Creegh River downstream of the site via both the Knocknahila Beg Stream has been assessed as having "good" quality status. The river has been assessed as being "not at risk".

The WFD River Waterbody Status 2013-2018 for the Annagh River River downstream of the site via both the Knocknahila Beg Stream has been assessed as having "moderate" quality status. The river has been assessed as being "at risk".

7.3.5.2 Inland Fisheries Ireland (IFI)

The Inland Fisheries Ireland (IFI) online database was assessed for records of fish species of conservation concern. No records were retrieved for the Annageeragh River, The Creegh River was surveyed in 2012 for Water Framework Directive (WFD) fish stock assessments and supported the following species: brown trout, salmon, sea trout flounder, European eel and three-spined stickleback. It was given a species richness grade of 5.

7.3.5.3 Freshwater pearl mussel – Clare County Council

Freshwater pearl mussel surveys were undertaken by Clare County Council (EirEco Environmental Consultants) in the Creegh and Annageeragh rivers in 2016. The report '*Freshwater Pearl Mussel Survey of the Doonbeg, Annageeragh and Creegh Rivers, Co. Clare'* outlines the results of the surveys and was consulted during this desk study.

5 no. adult mussels were recorded on the Annageeragh during the survey undertaken in 2016, including 2 large adult mussels located upstream of Annageeragh Bridge and 3 large adults located upstream of the disused railbridge downstream of Lisseyneillan Bridge. No mussels were recorded in the reaches upstream of Lisseyneillan Bridge, downstream of Knockahila Bridge or upstream of Knockahila Bridge. The report stated that although the Annageeragh has very low numbers of mussels it does have some suitable substrate. Much of the river has beeen modified by drainage and engineering works both historically and in recent years. The lower reaches, including just upstream of Annageeragh Bridge and downstream of Lissyneillan Bridge have a greater proportion of suitable substrate for mussels compared to reaches further upstream. These reaches have also been most affected by historical drainage and engineering works and the survey found that these reaches had high levels of filamentous green algal growth and fine silt and detritus at levels that exceed freshwater pearl mussel regulation thresholds (S.I. 296 of 2009).

A single adult mussel was recorded on the Creegh River, upstream of Coomacreehaun Bridge, during surveys undertaken in 2016. The report states that, although the Creegh was a good freshwater pearl mussel river in the past that the species can be considered effectively extinct in the Creegh catchment. The Creegh was also found to contain high levels of filamentous green algal growth and fine silt and detritus in more slow flowing reaches at levels that exceed freshwater pearl mussel regulation thresholds (S.I. 296 of 2009).

The report also refers to Stage 1 freshwater pearl mussel surveys undertaken by The Aquatic Services Unit, UCC in 2014 as part of the proposed windfarm development in the Slaghbooly/Booltiagh area.

Three sections of river were surveyed in 6km of channel downstream of Doo Lough. Spot checks were carried out at two bridges further downstream. No evidence of freshwater pearl mussel was recorded at any of the sites.

The report also refers to a Stage 1 survey of the Creegh River undertaken by Ryan Hanley in 2014. No evidence of mussels was recorded during surveys.

7.3.6 Conclusions of the Desk Study

The desk study revealed that the site of the proposed development is located within an area that is dominated by upland forestry and peatland habitats. There are no sites designated for nature conservation located within the proposed development footprint, however the grid connection passes adjacent to Cragnashingaun Bogs NHA.

The proposed development site has surface water connectivity downstream with Carrowmore Point to Spanish Point and Islands SAC, Carrowmore Dunes SAC and Mid-Clare Coast SPA via the Annageeragh, Creegh and Annagh rivers. These sites are further considered in the Natura Impact Statement prepared for the proposed development.

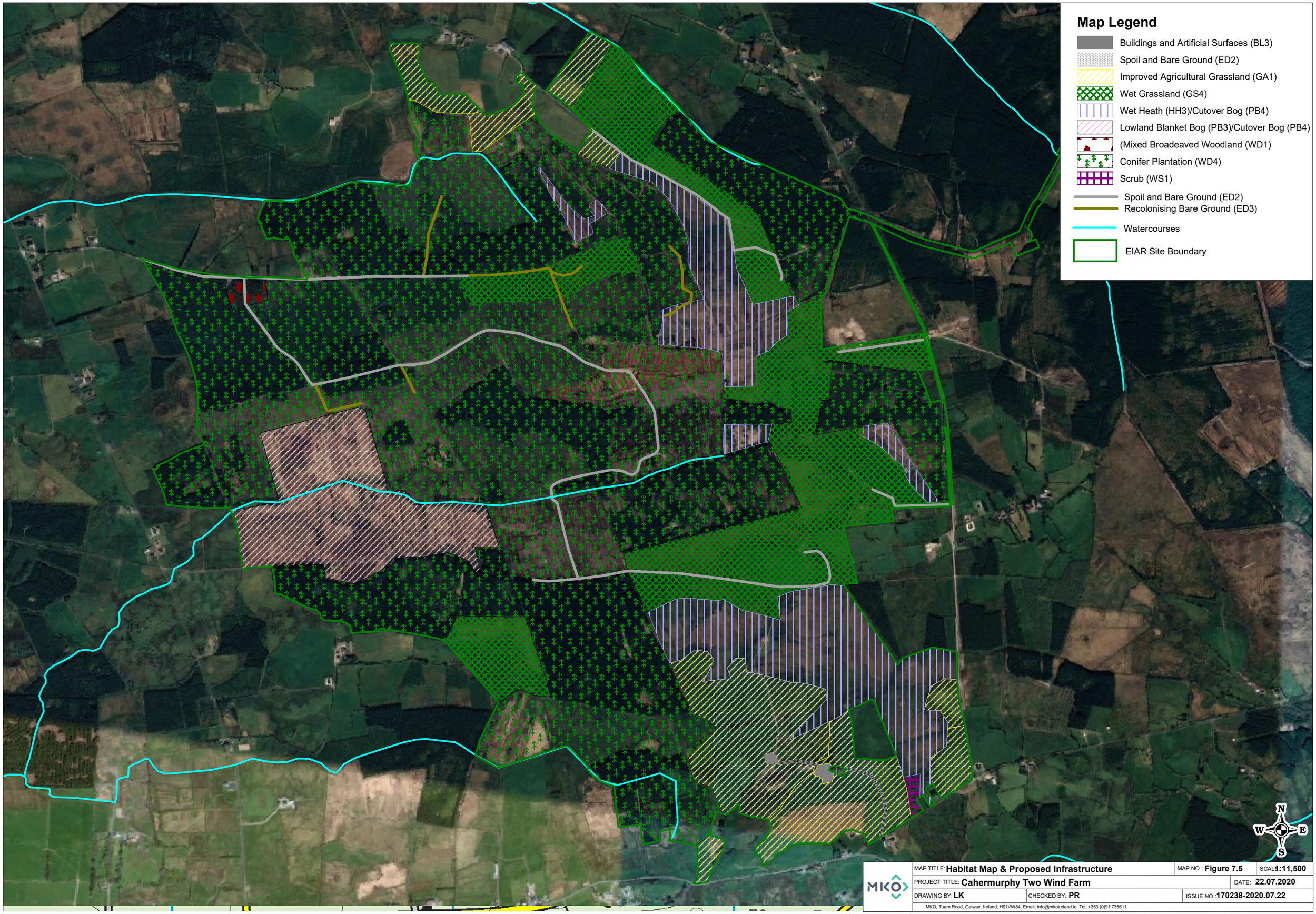
The proposed development is located within two freshwater pearl mussel catchments, the Annageeragh catchment and the Creegh catchment. However, the desk study revealed that freshwater pearl mussel can be considered effectively extinct in the Creegh river and that very few adult pearl mussels were recorded in the Annageeragh. Furthermore the Annageeragh has been modified by drainage and engineering works both historically and in recent years had high levels of filamentous green algal growth and fine silt and detritus at levels that exceed freshwater pearl mussel regulation thresholds (S.I. 296 of 2009).

A number of rare and protected habitats, flora and fauna have been recorded from the hectads in which the proposed development site is located. The field surveys were thus designed to identify habitats, flora and fauna, or additional ecological receptors occurring within the proposed development site.

7.4 Field Study

7.4.1 Habitats Present within the Proposed Development Site and Surrounding Area

Dedicated habitat surveys of the proposed development site, including the proposed grid connection route were undertaken on the following dates in 2019: 8th and 9th May, 19th July, 27th August, 4th September and 11th October and 14th May 2020. The majority of the site is characterised by coniferous forestry and is accessed via a network of existing forestry tracks and forestry rides. Other habitats present include wet heath, cutover bog, wet grassland and agricultural grassland. Habitats within the proposed development site were classified according to the guidelines set out in 'A Guide to Habitats in Ireland (Fositt, 2000), as described above in Section 5.2.3. Detailed botanical data from relevés recorded in peatland and grassland habitats are provided in Appendix 7-1 of this report. A habitat map of the site is provided in Figure 7.5. A habitat map is also provided with the proposed infrastructure footprint overlain in Figure 7.6. The habitats recorded within the proposed development site (excluding along the grid connection route) are listed in Table 7-99. Habitats along the proposed grid connection route are described in Section 7.4.1.2 below.



MAP TITLE: **Habitat Map & Proposed Infrastructure** | MAP NO.: **Figure 7.5** | SCALE: **1:11,500**

PROJECT TITLE: **Cahermurphy Two Wind Farm** | DATE: **22.07.2020**

DRAWING BY: **LK** | CHECKED BY: **PR** | ISSUE NO.: **170238-2020.07.22**

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Map Legend

- Buildings and Artificial Surfaces (BL3)
- Spoil and Bare Ground (ED2)
- Improved Agricultural Grassland (GA1)
- Wet Grassland (GS4)
- Wet Heath (HH3)/Cutover Bog (PB4)
- Lowland Blankte Bog (PB3)/Cutover Bog (PB4)
- (Mixed) Broadeaved Woodland (WD1)
- Conifer Plantation (WD4)
- Scrub (WS1)
- Spoil and Bare Ground (ED2)
- Recolonising Bare Ground (ED3)
- Watercourses
- Turbine Layout
- Proposed Met Mast Location
- Proposed Borrow Pit
- Proposed Substation
- Compound
- Proposed New Roads
- Exisitng Roads
- Alternative Grid Connection
- Proposed Grid Connection
- EIAR Site Boundary

N W E S

MAP TITLE: **Habitat Map & Proposed Infrastructure**		MAP NO.: **Figure 7.6**	SCALE: **1:11,500**
PROJECT TITLE: **Cahermurphy Two Wind Farm**			DATE: **22.07.2020**
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Table 7-9 List of habitats recorded within the proposed development site (including along the proposed grid connection routes)

Habitat Name	Fossitt Code
Conifer plantation	WD4
Wet grassland	GS4
Wet heath (peatland mosaic)	HH3
Cutover bog (peatland mosaic)	PB4
Lowland blanket bog (peatland mosaic)	PB3
Scrub	WS1
Spoil and bare ground	ED2
Recolonising bare ground	ED3
Buildings and artificial surfaces	BL3
Eroding/upland rivers	FW1
Mixed broadleaved woodland	WD1
Drainage ditches	FW4

The habitats recorded during the site visit are described in the sections below.

7.4.1.1 Habitats within the Proposed Development Site

7.4.1.1.1 *Conifer plantation (WD4)*

Almost half of the proposed development site (48.5%) is dominated by conifer forestry. This includes forestry (WD4) of various ages, including clear-felled areas, semi-mature and mature stands, and immature pre-thicket areas of both first and second rotation. Sitka spruce (*Picea sitchensis*) is the dominant species, with lodgepole pine (*Pinus contorta*) and larch (*Larix* sp.) also present in smaller quantities at a small number of locations. Mature conifer is interspersed with immature stands, typically comprised of Sitka spruce about 10m in height. At some locations, including to the north of T3, small areas of willow scrub and birch (*Betula* sp.) woodland are present as smalll pockets within the conifer plantation.

The understorey of the majority of mature conifer plantation in the development site is typically species poor with vegetation comprising predominantly of bryophytes including *Thuidium tamariscinum* and *Kinbergia praelonga*. Other occasional species include honeysuckle (*Lonicera periclymenum*) and bracken (*Peridium aquilinum*). Much of the conifer plantation within the site has been planted on peatland and therefore the understorey of immature plantation comprises peatland species including ling heather (*Calluna vulgaris*), purple moor grass (*Molinia caerulea*) and bilberry (*Vaccinium myrtillus*) as well as other species including Yorkshire fog (*Holcus lanatus*), sweet vernal grass (*Anthoxanthum odoratum*), common bent (*Agrostis capillaris*), soft rush (*Juncus effusus*) and tormentil (*Potentilla erecta*).

Vegetation of clear-felled areas typically comprised of rosebay willowherb (*Epilobium angustifolium*), Yorkshire fog, soft rush, cross-leaved heath (*Erica tetralix*), common sorrel (*Rumex acetosa*) and foglove (*Digitalis purpurea*).

Much of the proposed windfarm infrastructure is located within conifer plantation habitat (WD4) including Turbines 1, 2, 3, 4, 5, 7, 8 and 9, one of the proposed borrow pits, the majority of the proposed northern substation and the site compound.

Plate 7.1 Example of conifer plantation and clear felled area within the proposed development site

7.4.1.1.2 Peatland Habitats

In areas where conifer plantation is not the dominant habitat type on the development site, there are several areas of peatland habitat located within the development site boundary. These areas have typically been extensively altered by drainage and/or peat cutting. The peatlands primarily occur as a mosaic of degraded ***Wet Heath (HH3), Lowland blanket bog (PB3)*** and ***Cutover bog (PB4)*** and often grade into ***Wet Grassland (GS4)***, which dominates the surrounding agricultural lands. The development has been specifically designed to avoid these peatland mosaic of habitats insofar as is possible. However, there are some locations where the infrastructure unavoidably intersects with peatland.

T6 is located in an area of degraded peatland habitat (wet heath with small areas of cutover blanket bog) (Plate 7.2). The habitat in this area was dominated by purple moor grass (*Molinia caerulea*) ling heather *Calluna vulgaris*) and hare's tail cottongrass (*Eriophorum vaginatum*). Other species present inlcuded cross-leaved heath, heath rush (*Juncus squarrosus*), tormentil, bog myrtle (*Myrica gale*), *Sphagnum capillifolium, Sphagnum papillosum* and *Sphagnum subnitens, Racomitrium languinosum* and *Cladonia sp.*. A 2m x 2m releve was taken at the location of T6 and the results are included in the detailed botanical assessment report in Appendix 7-1 to this chapter.

Large areas of wet heath are also present to the north and south of T6. These are heavily grazed and trampled in places and interspersed with areas of rush-dominated wet grassland to the north of T6 and cutover bog with very small areas of lowland blanket bog to the south. These areas will not be impacted by the proposed infrastructure.

In addition to the above, there are peatland habitats within the proposed development site that have been completely avoided by the proposed development. Cutover bog and heath mosaics were recorded at various locations throughout the development site with small areas of lowland blanket bog located within these mosaics (Plate 7.3). Large degraded peatlands are located to the south of T10 and to the south and west of T4. Smaller areas are located adjacent to T3 and to the east of T8.

Plate 7.2 Wet heath (HH3) in the vicinity of T6. This habitat occurs as a mosaic with areas of cutover bog (PB4) and small areas of lowland blanket bog (PB3)

Plate 7.3 Example of Lowland blanket bog (PB3) which occurs as small pockets in a mosaic with cutover bog (PB4) and wet heath (HH3) (outside development footprint)

7.4.1.1.3 Wet grassland (GS4)

Wet grassland is common throughout the development site. The proposed southern substation and second proposed borrow pit are located entirely within wet grassland. T10 is located in an area of wet grassland (Plate 7.4) and approximately 230m of proposed new access road to T10 traverses wet grassland. Approximately 120m of new access road to T3 also traverses wet grassland. Wet grassland within the development site is typically dominated by soft rush (*Juncus effusus*), Yorkshire fog (*Holcus lanatus*) and common bent grass (*Agrostis capillaris*). Other species present in this habitat include sweet vernal grass, common sorrel, broad-leaved dock (*Rumex obtusifolius*), creping buttercup, marsh thistle (*Cirsium palustre*) and tormentil. The wet grassland habitat at many locations within the site is heavily grazed by cattle and sheep.

Plate 7.4 Example of Wet grassland (GS4) in the vicinity of T10

7.4.1.1.4 Mixed Broadleaved Woodland (WD1) and Scrub (WS1)

A small area of mixed broadleaved woodland is present within the proposed development site boundary to the north of T1 along the edges of existing forestry track. The woodland is dominated by sycamore (*Acer pseudoplatanus*) and beech (*Fagus sylvatica*) with occasional larch (*Larix* sp.). Understorey species inclue hard fern (*Blechnum spicant*) and bracken. The woodland lies outside the infrastructure footprint. This is shown in Plate 7.5.

Scrub was recorded at various locations throughout the conifer plantations on the site. This was in generally small areas of old clear fell and was in pockets that were too small to be accurately mapped. One area of willow scrub is present to the north of T2 (Plate 7.6 7.6) within a block of conifer plantation. Other species include bramble (*Rubus fruticosus* agg.) and rowan (*Sorbus aucuparia*). Another small area of scrub is also present along the southern boundary of the development site.

Plate 7.5 Mixed broadleaved woodland (WD1) with beech and sycamore within the development site

Plate 7.6 Willow scrub to the north of T2

7.4.1.1.5 Spoil and Bare Ground (ED2)

The proposed development site is accessed by a network of existing forestry tracks categorised as ***Spoil and bare ground (ED2)*** (Plate 7.7). Upgrading of the existing tracks is proposed across the site as shown in Figure 4.1 of the EIAR. Forestry track verges consist of ***Dry meadows and grassy verges (GS2)*** habitat, ***wet grassland (GS4)*** and peatland habitat vegetation. Species recorded mainly comprised of Yorkshire fog, ribwort plantain (*Plantago lanceolata*), red clover (*Trifolium pratense*), selfheal (*Prunella vulgaris*), foxglove (*Digitalis purpurea*), tormentil, soft rush, hard rush (*Juncus inflexus*), ling heather, purple moor grass and occasional devil's bit scabious (*Succisa pratensis*).

Plate 7.7 Forestry track classified as Spoil and bare ground (ED2

7.4.1.1.6 Recolonising Bare Ground (ED3)

A number of existing forestry and land access tracks have become overgrown with vegetation and are classified as ***Recolonising bare ground (ED3)*** (Plate 7.8). Whereas some were drier in nature and supported species including hawkbits (*Leontodon* sp) and ragwort (*Senecio jacobea*), others contained vegetation typical of wet grassland and/or heath including ling heather, purple moor grass, Yorkshire fog, devil's bit scabious (*Succisa pratensis*) as well as bryophytes including *Sphagnum* sp. and *Hylcomium splendens*.

Plate 7.8 Forestry track classified as Recolonising bare ground (ED3)

7.4.1.1.7 Eroding/Upland Stream (FW1)

A number of watercourses drain the proposed site. The northern section of the site is drained by the Knocknahilla Beg Stream and the Lissyneillan Stream.The southern section of the site is drained by the Knocknahila More stream and a small unnamed stream which passes in close proximity to the north of T9. The majority of the streams were <1m in width, shallow with a cobble, gravel and silt substrate with no instream macrophytes. Flow ranged from stagnant to fast and water clarity was poor. The majority of the streams were bordered by forestry and the banks were heavily vegetated with bramble (*Rubus fruticosus agg.*), soft rush, Yorkshire fog, common bent grass, purple moor grass, nettle (*Urtica dioica*) and wild angelica (*Angelica sylvestris*) (Plate 7.9). The rivers have been subject to detailed assessment downstream of the development site and the results are presented in the relevant section below. Numerous Drainage ditches (FW4) are present throuhgout the development site, many bordering forestry tracks.

Plate 7.9 Example of an Eroding upland stream (FW1) in the proposed development site

7.4.1.2 Habitats along the Grid Connection Route Options

A connection between the proposed development site and the national electricity grid will be necessary to export electricity from the proposed wind farm.

There are 2 No. substations options; however, only one substation will ultimately be constructed. This is to allow the national grid operator, ESB/Eirgrid flexibility when deciding on which is technically preferable from their perspective.

The proposed wind farm will connect to the grid via one of the following methods:

- Option A: It is proposed to construct a 38 kV substation at the northern end of the site and to connect from here to the existing Booltiagh 110kV substation, located approximately 7 kilometres to the southeast of the site. Option A also includes for an alternative cable route running from the proposed onsite substation south to the access road and north along the local road to the east of the site. The alternative cable route option measures approximately 1.7 km in length. Connection via the Booltiagh route would comprise underground cabling, measuring approximately 12.1 km in total, located on existing forestry and agricultural land and within the public road corridor.

Or

- Option B: It is proposed to construct a 38kvV substation at the south eastern end of the site and to connect from here to the existing Booltiagh 110kV substation, located approximately 7 kilometres to the southeast of the site. Connection via the Booltiagh route would comprise underground cabling, measuring approximately 12.1 km in

total, located on existing forestry and agricultural land and within the public road corridor.

The proposed substation options occur in both ***Conifer plantation (WD4)*** and ***Wet grassland (GS4).*** In addition to these habitats the grid connection within the wind farm site traverses a small section of degraded ***Wet Heath (HH3)/Cutover Bog (PB4)*** mosaic as well as exisitng track categorised as ***Spoil and bare ground (ED2)*** and ***Recolonising bare ground (ED3)*** as shown in Figure 7.6. Starting from the eastern site boundary, the grid connection route is approximately 12.1km and runs in an east and southeastward direction across Cahermurphy, Drummin, Doolough and Booltiagh townlands from the permitted Cahermurpy wind farm to connect to the Booltiagh Wind Farm.

The majority of the proposed route runnning from west to east, south of Doo Lough, traverses ***Conifer plantation (WD4)*** of various ages including semi-mature and mature stands, and immature pre-thicket areas dominated by sitka spruce (Plate 7.10). The proposed route passes in close proximity to Cragnashingaun Bogs NHA which consists of Lowland blanket bog (PB3) (Plate 7.11), however the route is restricted to forestry track associated with the adjacent conifer plantation and does not encroach on this peatland habitat.

The grid connection then turns in a northward direction along an existing forestry trackway classified as ***Recolonising bare ground (ED3)*** prior to joining the local roadway south of Doo Lough (Plate 7.12, Plate 7.13). The grid connection route continues along the local roadway south of Doo Lough classified as ***Buildings and artificial surfaces (BL3)*** for approximately 966m. Other habitats traversed by this section of the proposed route include ***Dry meadows and grassy verges (GS2), Earth banks (BL2), Scrub (WS1)*** and ***Stone walls and other stone work (BL1)*** (Plate 7.13),

The grid connection route continues in a southward direction to cross ***Wet grassland (GS4)*** grading into a mosaic of Wet grassland (GS4) and ***Lowland blanket bog (PB3)*** (Plate 7.14). It runs along a trackway classified as ***Recolonising bare ground (ED3)*** and ***Recently felled woodland (WS5)*** prior to reaching the Booltiagh Wind Farm where it will be laid within existing paved roadway and existing trackway classified as ***Spoil and bare ground (ED2), Recolonising bare ground (ED3)*** with mosaic areas of ***Wet grassland (GS4) and Conifer plantation (WD4)*** (Plate 7.15 - Plate 7.17).

Plate 7.10 Conifer Plantation along the eastern section of the proposed grid connection route

Plate 7.11 The propsoed cable route passes in close proximity to Cragnashingaun Bogs pNHA which comprises Lowland blanket bog habitat, however, the cable route runs along the edge of forestry plantation and does not encroach on the peatland habitat

Plate 7.12 Trackway classified as Recolonising bare gorund (ED3) along the north-eastern section of the proposed grid connection route

Plate 7.13 Exisitng roadway corridor south of Doo Lough classifed as Buildings and Artificial surfaces (BL3) with Conifer Plantation (WD4) and Scrub (WS1)

Plate 7.14 Wet Grassland (GS4)/Lowland blanket bog (PB3) mosaic towarsd the south eastern section of the route.

Plate 7.15 Trackway classified as Recolonising bare ground (ED3) adjacent to Conifer plantation (WD4) and Lowland blanket bog (PB3)/Wet grassland (GS4) mosaic looking east to Boolitagh Wind Farm

Plate 7.16 Clearfell classified as recently felled woodland (WS5)

Plate 7.17 Existing roadway classified as Buildings and artificial surfaces (BL3) within the Boolitagh Wind Farm

7.4.1.2.1 Watercourse Crossings Along the Proposed Cable Route

A total of 9 watercourse crossings were recorded along the cable route. For watercourses where no crossing currently exists the proposed cable will pass over the watercourse over a bottomless box culvert or pre-cast concrete slab in a standard trefoil arrangement. Where a concrete pipe or culvert crossing exists the cable will pass over the culvert in a flatbed formation.

All 9 watercourses along the proposed grid connection route consist of small streams classified as ***Eroding upland rivers (FW1)*** and ***Drainage ditches (FW4)***. Streams ranged from 0.5m to 1m in width, and had substrates with varying mixes of cobbles, boulders, gravels with some silts. Drainage ditches had a predominantly peaty substrate. Flow ranged from slow to fast. An example of a typical stream crossed by the grid connection is shown in Plate 7.18.

The banks of some of the smaller watercourses were heavily vegetated with bramble, soft rush, purple moor grass and Yorkshire fog. Drainage ditches were mostly heavily vegetated and ranged from having standing water to slow flow, however some were open in nature. No otter breeding or resting sites were recorded at any of the watercourses and the watercourses are of low suitability for breeding otter or for other aquatic species such as freshwater pearl mussel and Atlantic salmon. It is likely that many of the watercourses are utilised by otter for commuting and foraging however. The watercourses identified along the proposed cable route, and the method of crossing are listed in Table 4-4 in Chapter 4. The locations of the watercourse crossings are also illustrated in Figure 7.7.

Plate 7.18 Watercourse crossing No. 4 along proposed grid connection route in the townland of Doolough

7.4.1.3 Habitats Along the Access Road

It is proposed to access the site of the Proposed Development via an existing access track off the local road to the east of the site which is categorised as Spoil and bare ground (ED2). Habitats present along the proposed access route include Conifer platation (WD4) and Wet grassland (GS4) as shown in Plate 7.19.

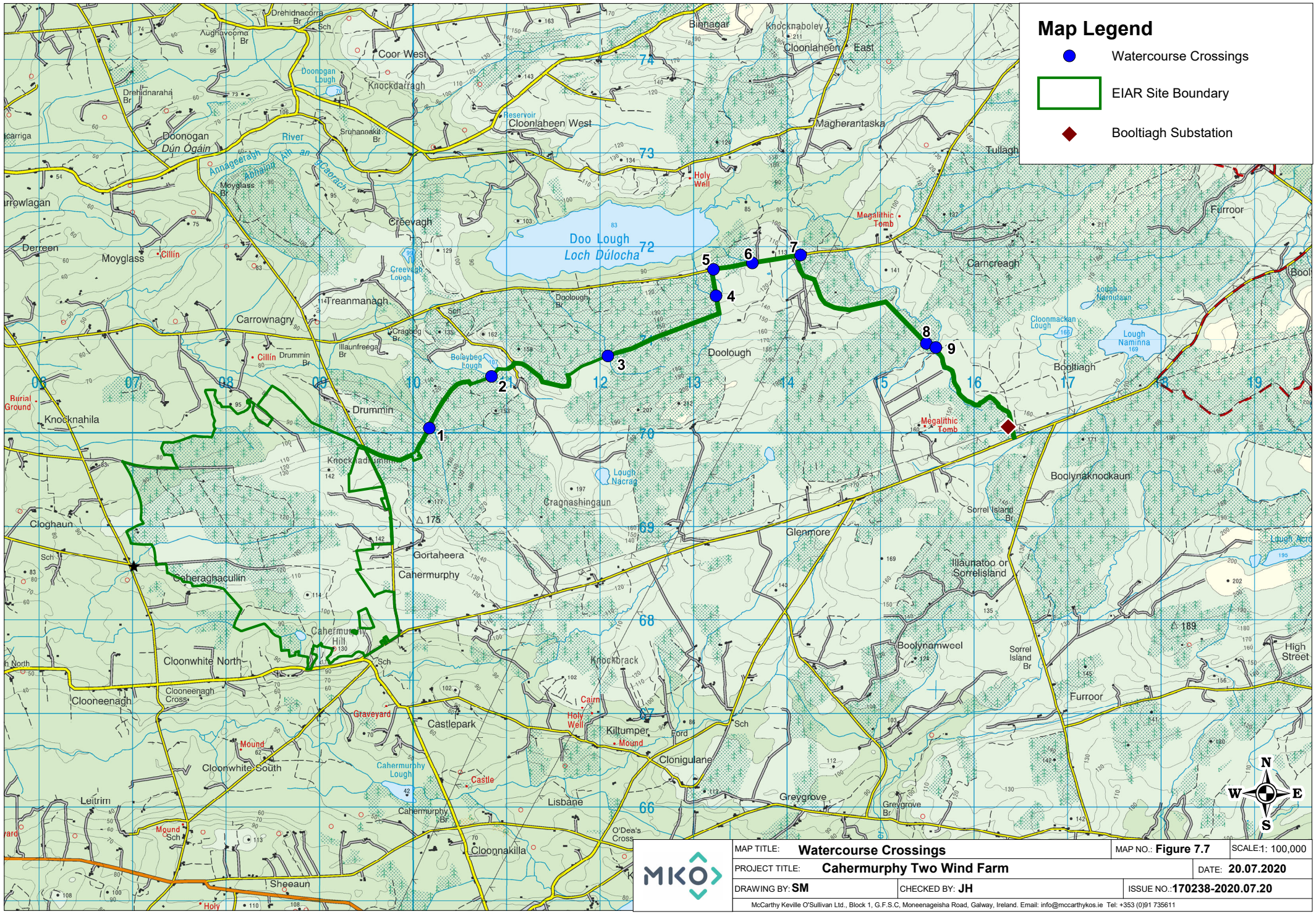
Plate 7.19 Exisiting access track comprising Spoil and bare ground (ED2) and adjacent Wet grassland (GS4) and Conifer plantation (WD4).

7.4.1.4 Protected Flora

No botanical species listed under the Flora (protection) Order (1999, as amended 2015), listed in the EU Habitats Directive (92/43/EC), or listed in the Irish Red Data Books were recorded within the proposed development site. All species recorded are common in the Irish landscape. No rare and protected plant species recorded in the desk study, including those obtained from NPWS data request (see Table 7-5 Records for rare and protected species, NPWS.), were recorded within the proposed development site.

7.4.1.5 Invasive Species

During field 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. No invasive species were recorded within the proposed development site. However, Rhododendron was recorded at a number of locations along the grid connection route. The locations of Rhododendron are illustrated on Figure 7.8.



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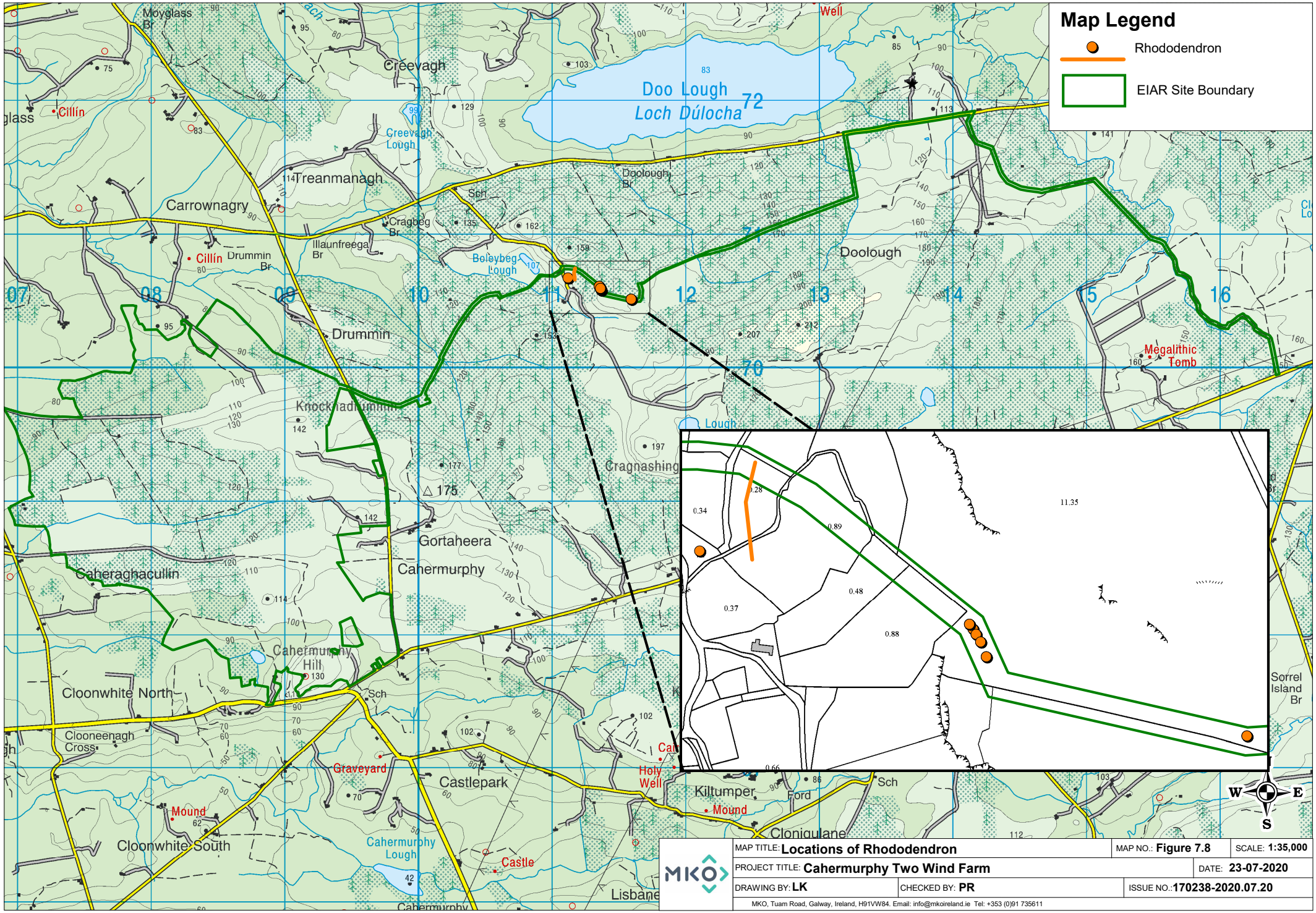

MAP TITLE: **Locations of Rhododendron**		MAP NO.: **Figure 7.8**	SCALE: **1:35,000**
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7.4.1.6 Fauna

The walkover survey was designed to detect the presence, or likely presence, of a range of protected species, including birds, bats, otter and badger. Potential suitable habitats were investigated for signs of animal presence. The following subsections provide a breakdown of the species recorded within the proposed development site during the site visit and assessment.

7.4.1.6.1 *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 employed a combination of methods, including desktop study, habitat and landscape assessments, roost inspections, manual activity surveys and static detector surveys at ground level and at height.The results of the bat surveys are described in full in the bat survey report included as Appendix 7-2 of this EIAR.

Roost Surveys

One structure, which is being retained, was identified within the proposed site boundary (IG Ref: 109390 167890). The occupied dwelling had a slate roof with plastic fascias and soffits. A limited number of potential access points were identified in gaps in the ridge slates.

Emergence surveys were carried out in spring and autumn in accordance with Collins (2016). Two surveyors were equipped with Bat Logger M bat detectors (Elekon AG, Lucerne, Switzerland). In spring, four common pipistrelle bats were observed emerging from the rear of the house at dusk. In autumn, no bats were observed emerging from the building, but one bat was seen feeding continuously in the area during the emergence survey. Multiple sheds were located adjacent to the main dwelling, but no evidence of bats was found.

The surrounding habitats were assessed as largely unsuitable for roosting bats with poor connectivity for commuting and foraging bats. No trees with significant bat roost features were identified during the survey and no evidence of bat use was recorded elsewhere during the roost assessment.

Manual Transects

Manual transects were undertaken in spring, summer and autumn 2019. Bat activity was recorded on all surveys. A total of 561 bat passes were recorded. In general, Common pipistrelle (n=404) was recorded most frequently, followed by soprano pipistrelle (n=85), Leisler's bat (n=37), brown long-eared bat (n=17), *Myotis* sp. (n=12) and *Pipistrelle* sp. (n=6). However, species composition and activity levels varied significantly between surveys. Transect survey results were calculated as bat passes per km surveyed (to account for differences in survey effort). Plate 4-1 in Appendix 7-2 presents results for individual species per survey period.

Ground-level Static Surveys 2019

In total, 31,939 bat passes were recorded across all deployments. In general, soprano pipistrelle (n=15,786) and common pipistrelle (n=12,820) occurred most frequently, while *Myotis* sp. (n=1,319), Leisler's bat (n=1,205) and brown long-eared bat (n=807) were significantly less. Lesser horseshoe bat (n=2) was identified at one detector in one season only. Plate 4-2 in Appendix 7-2 presents relative species composition across all ground-level static detector surveys.

Surveys at Height 2019

Simultaneous surveying at ground level and at height was undertaken using an SM3 static detector. One U1 microphone was attached at height during the construction of the meteorological mast while another U1 microphone was placed 2m from ground level.

In 2019, 57 nights of simultaneous bat monitoring at ground level and at height was achieved. In total, 1,338 bat passes were recorded with bat activity significantly higher at ground level (99%) compared to activity at height (1%) (Plate 4-5, Appendix 7-2). Myotis sp. (n=12) and soprano pipistrelle (n=5) were recorded at height. No bat passes were recorded during Mast-1. Mast-1 to Mast-4 represents deployment efforts.

7.4.1.6.2 *Non-volant mammals*

Badger

Low levels of badger activity were recorded within the proposed development site, restricted to foraging signs. No badger setts were recorded within the proposed development site or construction footprint. No evidence of badger was recorded along the proposed grid conenction route options. Given the nature of the habitats in the proposed development site however, it is likely that this species occurs, at least on occasion.

Otter

No otter breeding or resting sites were recorded within the proposed development site during the dedicated surveys. There is potential for otter to use the small watercourses within the site as well as along the proposed grid connection route for foraging and commuting. The species may occur within the development site, at least on occasion. Due to the forested nature of the site, the fisheries potential of the upper reaches of watercourses within the site is poor and therefore otter are more likely to utilise the lower reaches of the watercourses, downstream of the proposed development site. Otter prints were identified under a bridge at a kick-sampling Site 3 on the Lissyneillan stream downstream of development site.

Other mammals

Mustelid scats were recorded within forestry close to the location of T8. These were likely to be likely to be pine marten (*Martes martes*), given their size, shape and location on top of fallen tree trunks. Red squirrel (*Sciurus vulgaris*) feeding signs were presnent in forestry in proximity to T1, however no dreys were recorded within the proposed development footprint. The scats of red fox (*Vulpes vulpes*) were also recorded in a number of areas within the development site. Irish hare (*Lepus timidus ssp. hibernicus*) was also observed within the development site boundary.

Given the size and variety of habitats in the proposed development site, other mammals such as Pygmy Shrew (*Sorex minutus*), Hedgehog (*Erinaceus europaeus*) and Stoat (*Mustela erminea*) are also likely to be present, at least on occasion. The recorded evidence does not suggest that the development site is utilised by populations of higher than local significance. Consequently, these species were not considered as KERS and further assessment was not deemed necessary.

7.4.1.6.3 Reptiles and Amphibians

Common frog (*Rana temporaria*) was recorded at a number of locations throughout the development site in wet grassland and peatland habitats. The species is likely to breed in wet habitats within the development site boundary. Common lizard (*Zootoca vivipara*) and smooth newt (*Lissotriton vulgaris*), while not recorded during the site visits, are likely to occur within the development site.

It is considered that the proposed development will not result in a significant loss of suitable habitat for reptiles and amphibians. It is considered that suitable habitat is extremely widespread in the development site and beyond. No likely significant effects on these species are anticipated and therefore further survey/ assessment was not deemed necessary.

7.4.1.6.4 Terrestrial Invertebrates

A variety of invertebrate species were recorded during site visits, however no protected or threatened species were identified. The following species were recorded during walkover surveys in 2019: buff-taield bumblebee (*Bombus terrestris*), white-tailed bumblebee (*Bombus lucorum*), red-tailed bumblebee (*Bombus lapidarius*), common carder bee (*Bombus pascuorum*), common hawker (*Aeshna juncea*), comon blue damselfly (*Enallagma cyathigerum*), peacock butterfly (*Inachis io*), medow brown butterfly (*Maniola jurtina*), green-veined white butterfly (*Pieris napi*) and small tortoiseshell butterfly (*Aflais urticae*).

7.4.1.6.5 Marsh fritillary

The desk study identified records for marsh fritillary in the wider area. Therefore dedicated marsh fritillary larval web surveys were undertaken in areas of suitable habitat throughout the development site. No evidence of marsh fritillary was recorded within the proposed development site. The larval foodplant, devil's bit scabious (*Succisa pratensis*), was recorded at a number of locations within the development site, mostly in grassy verges, existing grassy access tracks and areas of wet grassland and wet heath. Despite a comprehensive search for larval webs in these locations no webs were reorded. No adult marsh fritillary were recorded during any of the site vists.

7.4.1.6.6 Freshwater pearl mussel

Assessments of the watercourses within the development site for suitability for freshwater pearl mussel (*Margaritifera margaritifera*) were undertaken on the 11th October 2019. The watercourses within the development boundary were generally small, <1m in width and none were suitable to support freshwater pearl mussel.

Dedicated assessments were also undertaken outside the proposed development site at each of the streams that flow off the site in both the Annageeragh and Creegh catchments. These assessments were undertaken to determine whether there was any suitable habitat or potential for populations to be present in close proximity downstream of the proposed development site. The locations of the streams that were sampled are provided Figure 7.1 above.

Site 1 was at E107533 N171081 on the Knocknahila Beg Stream in the Annageeragh catchment. This was located approximately 1.2km from the wind farm development. Whilst this stream was larger than the streams that were recorded on the site, it was still very unstable and indicative of an upland watercourse with variable water levels. There was evidence of cattle access at the survey point. It provided poor quality habitat for freshwater pearl mussel and none were recorded during the dedicated survey undertaken. This location is shown in Plate 7.20.

Plate 7.20 Knocknahila Beg Stream at sampling point

Site 2 was at E106433 N169847 on the Lissyneillan Stream. The sampling point was at a bridge on the local road approximately 1km to the west of the development site. This was a small stream/drain that had a flow but was very overgrown with brambles and trees and was shallow. It provided no suitable habitat for freshwater pearl mussel. This location is shown in Plate 7.21.

Plate 7.21 Lissyneillan Stream at sampling point

Site 3 was at E107011 N168578 on the Knocknahila More Stream approximately 300 metres to the west of the proposed development site. This was a small stream of approximately 2m in width and 15cm in depth during the survey. The channel was very steep and fast flowing at the sample point. It was a very steep upland stream and did not provide suitable habitat for freshwater pearl mussel. This location is shown in Plate 7.22.

Plate 7.22 Knocknahila More Stream at sampling point

Site 4 was at E107232 N167903 on the Clooneenagh stream approximately 600m to the west of the wind farm development site. This was a small, steep and fast flowing stream of approximately 2m in width. The stream was heavily overgrown with bramble and gorse. Though it did have a substrate of cobbles and gravels, the streambed was that of an unstable upland stream that does not provide suitable habitat for freshwater pearl mussel at this location. This location is shown in Plate 7.23.

Plate 7.23 Clooneenagh Stream at sampling point

7.4.1.6.7 Aquatic and River Habitat Surveys

In order to provide a baseline against which water quality in the watercourses downstream of the site can be monitored throughout construction and operation, river habitat surveys and macroinvertebrate sampling was carried out downstream of the site of the proposed development at the four sites where freshwater pearl mussel assessments were undertaken. The survey locations are shown on Figure 7.1 above.

7.4.1.6.8 Site 1

Site 1 was at E107533 N171081 on the Knocknahila Beg stream in the Annageeragh catchment. The sampling point was at a bridge on the local road to the north of the development site. The properties of the stream at the sample point are shown in Table 7-1010 below:

Table 7-10 Properties of the stream at sample point (E107533, N171081, Annageeragh catchment)

Property	Recorded Value
Bank width	Approx. 7m
Wet width	Approx 5m
Average depth	10-20cm
Velocity at sampling	Fast
Colour	Highly coloured
Clarity	Clear
Sampled in	Riffles
Dominant substrates	Cobble, gravel, fine gravel, sand, silt
Main land use upstream	Pasture

There was no sign of filamentous algae, gelatinous complexes, or sewage fungus. Submerged vegetation included water starwort (*Calltriche* sp) while emergent vegetation included floating sweet grass (*Glyceria fluitans*) and brooklime (*Veronica beccabunga*). The banks were vegetated with soft rush (*Juncus effusus*), marsh ragwort (*Senecio aquaticus*), meadowsweet (*Filipendula ulmaria*), meadow buttercup (*Ranunculus acris*) and cuckoo flower (*Cardimine pratensis*), with some hawthorn (*Crataegus monogyna*) and gorse (*Ulex europaeus*), however there was no significant shading of the stream. There was cattle access to the stream and evidence of manure/slurry ingress along with extensive poaching of the bankside.

The results (i.e. identificationa and numbers of aquatic macroinvertebrates) of two minutes of kick sampling and 5 minutes of stonewashing are shown in Table 7-1111.

Table 7-11 Results of sampling at at sample point (E107533, N171081, Annageeragh catchment)

Order	Family	Abundance Category	Sensitivity Group
Ephemeroptera	*Baetis rhodani*	Common (6-20)	C
	Heptageniidae	Few (1-5)	A
Plectoptera	Non-Leuctra	Few (1-5)	A
Trichoptera (casless)	Non-cased	Few (1-5)	C
Diptera	Simulid larva	Few (1-5)	C

Taking into account the biological data, the stream has been assigned a Q-value of Q3-4, corresponding to water quality class B (slight pollution). This is typical of such an upland stream.

7.4.1.6.9 Site 2

Site 2 was at E106433 N169847 on the Lissyneillan Stream. The sampling point was at a bridge on the local road to the west of the development site. The properties of the stream at the sample point are shown in Table 7.12 below:

Table 7-12 Properties of the stream at sample point (E106433, N16984, Annageeragh catchment)

Property	Recorded Value
Bank width	Approx. 2m
Wet width	Approx 1.5m
Average depth	10-20cm
Velocity at sampling	Moderate
Colour	Highly coloured
Clarity	Clear
Sampled in	Glides
Dominant substrates	Sand, silt
Main landuse upstream	Pasture

There was no sign of filamentous algae, gelatinous complexes, or sewage fungus. There was no submerged or emergented vegetation. The banks were vegetated with soft rush (*Juncus effusus*), wild angelica (*Angelica sylvestris*), bramble (*Rubus fruticosus* agg.), bracken (*Pteridium aquilinum*) and nettle (*Urtica dioica*) and tree species including hawthorn, willow (*Salix* sp.), sycamore (*Acer pseudoplatanus*) and sitka spruce (*Picea sitchensis*) which created heavy shading. The substrate of sand and silt did not provide conditions suitable for a valid indication of water quality using the Q value system.

The results (i.e. identification and numbers of aquatic macroinvertebrates) of two minutes of kick sampling and 5 minutes of stonewashing are shown in

Table 7-1313.

Table 7-13 Results of sampling at sample point (E106433, N16984, Annageeragh catchment)

Order	Family	Abundance Category	Q value
Crustacea	Gammarus spp.	Few (1-5)	C
Trichoptera (caseless)	Non-cased	Few (1-5)	C
Oligochaeta		Few (1-5)	N/A

Taking into account the biological data, it was not valid to assign a Q value. There were no signs of pollution such as dense growth of algae or sewage fungus but the natural silty/sandy substrate and deep shade do not provide suitable conditions for many of the species that are used as indicators of water quality.

Otter prints were identified under the bridge at this location.

7.4.1.6.10 **Site 3**

Site 3 was at E107011 N168578 on the Knocknahila More stream. The sampling point was at a bridge on the local road to the north of the development site. The properties of the stream at the sample point are shown in

Table 7-1414 below:

Table 7-14 Properties of stream at sample point E107011, N168578, Creegh catchment)

Property	Recorded Value
Bank width	Approx. 2m
Wet width	Approx 2m
Average depth	15cm
Velocity at sampling	Fast
Colour	Highly coloured
Clarity	Clear
Sampled in	Riffles
Dominant substrates	Boulder, Cobble
Main landuse upstream	Pasture

Abundant algal growth was recorded within the river. Submerged vegetation included common water-moss (*Fontanalis antipyretica*). The banks were vegetated with soft rush (*Juncus effusus*), marsh ragwort (*Senecio aquaticus*), meadow buttercup (*Ranunculus acris*) and bramble (Rubus fruticosus agg.).

The results (i.e. identificationa and numbers of aquatic macroinvertebrates) of two minutes of kick sampling and 5 minutes of stonewashing are shown in Table 7.15.

Table 7-15 Result of sampling at sample point E107011, N168578, Creegh catchment)

Order	Family	Abundance Category	Q Value
Plectoptera	Non-Leuctra	Common (6-20)	A
Trichoptera (caseless)	Non-cased	Few (1-5)	C
	Cased	Few (1-5)	B
Diptera	Simulid larva	Few (1-5)	C
Hydracarina	Hydracarina	Few (1-5)	C
Mosquito larva		Few (1-5)	N/A

Taking into account the biological data, the stream has been assigned a Q-value of Q4, corresponding to water quality class A (Unpolluted). However, the abundant algal growth was untypical of such an upland stream.

7.4.1.6.11 Site 4

Site 4 was at E107232 N167903 on the Clooneenagh stream. The sampling point was at a bridge on the local road to the north of the development site. The properties of the stream at the sample point are shown in

Table 7-1616 below:

Table 7-16 Properties of stream at sample point (E107232, N167903, Creegh catchment)

Property	Recorded Value
Bank width	Approx. 2m
Wet width	Approx 1.5m
Average depth	15cm
Velocity at sampling	Fast
Colour	Highly coloured
Clarity	Clear
Sampled in	Riffles, Pools
Dominant substrates	Boulder, Cobble, Gravel
Main landuse upstream	Pasture

There was no sign of filamentous algae, gelatinous complexes, or sewage fungus. Submerged vegetation included comon water-moss (*Fontanalis antipyretica*) and emergent vegetation included floating sweet grass (*Glyceria fluitans*). The banks were vegetated with soft rush (*Juncus effusus*), meadowsweet (*Filipendula ulmaria*), wild angelica (*Angelica sylvestris*), cock's foot (*Dactylis glomerata*) and bramble (*Rubus fruticosus* agg.).

The results (i.e. identification and numbers of aquatic macroinvertebrates) of two minutes of kick sampling and 5 minutes of stonewashing are shown in Table 7-1717.

Table 7-17 Results of sampling at sample point (E107232, N167903, Creegh catchment)

Property	Recorded Value	Abundance Category	Q Value
Crustacea	Gammarus sp.	Common (6-20)	C
Ephemeroptera	Baetis rhodani	Common (6-20)	C
Trichoptera	Uncased	Few (1-5)	C
Plecoptera	Non-leuctra	Few (1-5)	A
Diptera	Simuliidae	Few (1-5)	C
Hirudinea		Few (1-5)	C/D

Taking into account the biological data, the stream has been assigned a Q-value of Q3-4, corresponding to water quality class B (Slight Pollution).

7.4.1.7 Importance of Ecological Receptors

Table 7-1818. 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 (KERs).

Table 7-18 Importance of Ecological Receptors

Habitat and Geographic Importance	KER Y/N	Rationale
Habitats of Local Importance (Lower Value)	*N*	The following habitats that were recorded throughout the proposed development site were highly modified from their natural state and were of low ecological significance or biodiversity value: Conifer Plantation (WD4), Wet Grassland (GS4), Recoloning Bare Ground (ED3), Spoil and Bare Ground (ED2), Scrub (WS1), Buildings and Artificial Surfaces (BL3).
Mixed broadleaved woodland (WD1) Local Importance (Higher Value)	*N*	This habitat, although located within the proposed development site, is not located within the proposed development footprint and therefore will be not directly impacted by the proposed development. No pathways for indirect effects on this habitat was identified. Therefore this habitat is not considered to be a KER.
Peatland Habitats including a mosaic of: Wet heath (HH3), Lowland blanket bog (PB3), Cutover Bog (PB4) County Importance	*Y*	The peatland habitats within the proposed development site occur primarily in mosaics of Cutover Bog and Wet Heath with very small areas of Lowland Blanket Bog. The majority of these peatland mosaics are degraded. through, drainage, turf cutting and grazing. They are also fragmented by conifer plantations. The peatland habitats have been assigned County Importance because they contain areas of the following Annex I habitats in a degraded and fragmented state: • North Atlantic wet heaths with *Erica tetralix* [4010] • Blanket bogs (* if active bog) [7130] The proposed development has been designed to avoid these peatland habitats where possible, but there is potential for direct and indirect effects thereon and therefore they have been included as a KER.
Eroding Upland Rivers (FW1) Local Importance (Higher Value)	*Y*	The watercourses on the site of the proposed development are small in size and heavily modified through drainage associated with agriculture, forestry and peat cutting. However, they do provide downstream connectivity with the Creegh and Annageeragh rivers,

Habitat and Geographic Importance	KER Y/N	Rationale
		both of which are known to support low numbers of freshwater pearl mussel and other sensitive ecological receptors such as Atlantic salmon and brown trout. These watercourses also have downstream connectivity, via these watercourses, to Carrowmore Point to Spanish Point and Islands SAC and Carrowmore Dunes SPA. The watercourses provide semi-natural habitat types with high biodiversity in the local context. In addition, they provide a link to habitats and species of higher ecological value downstream. They are assigned *Local Importance (higher value)* (NRA 2009) as they help maintain links between features of higher ecological value. No instream works are proposed as part of the development. However, there is potential for inidrect effects on this habitat in the form of pollution in various forms. Therefore Eroding upland rivers (FW1) within the proposed development are considered to be a KER.
Badger Local Importance (Higher Value)	*N*	No badger setts were identified within the proposed development site or development footprint. No evidence of a regularly occurring population of significance was recorded within the proposed development site during the surveys undertaken. Direct impacts on badger are not anticipated. There will be no loss of resting or breeding places associated with the development. Therefore, badger has not been included as a KER.
Otter Local Importance (Higher Value)	*Y*	No otter resting or breeding places were identified within the proposed development site. Direct impacts on otter are not anticipated. There will be no loss of resting or breeding places associated with the development. Whilst no signs of otter activity were recorded on the site of the proposed development, it is likely that there is a regularly occurring population of this Annex II species in watercourses that are downstream in the Creegh and Annageeragh catchments. The proposed development has the potential to result in indirect effects on the receptor (as a result of deterioration in habitat or disturbance during construction/decomissioning) and otter is therefore included as a KER for further assessment.
Bat species Local Importance (Higher Value)	*Y*	The populations of bats recorded on the proposed development site represent a regularly occurring

Habitat and Geographic Importance	KER Y/N	Rationale
		population of species that are listed on Annex IV of the EU Habitats Directive. The proposed development has potential to result in direct and indirect effects on the receptor.Therefore, bats are included as a KER for further assessment.
Fish and other aquatic species including freshwater pearl mussel Local Importance (Higher Value)	*Y*	The downstream watercourses provide suitable habitat for a range of aquatic species including Atlantic salmon, brown trout and freshwater pearl mussel. This represents resident populations of species that are listed on Annex II of the Habitats Directive and protected under the Wildlife Acts. No instream works are proposed as part of the development therefore no potential for direct impact on these species exists. The proposed development has the potential to result in indirect effects on aquatic receptors as a result of deterioration in water quality and it is therefore included as a KER for further assessment.
Reptiles and amphibians Local Importance (Lower Value)	*N*	Common frog was recorded in wet grassland and peatland habitats throughout the proposed development site. Populations were not considered significant at the local level. The site of the proposed development did provide some habitat for these species but it was not considered significant in the context of the overall abundance of the habitat in the wider area. Although there will be some loss of these habitats as a result of the proposed works, the loss will not result in a significant loss of suitable habitat for reptiles and amphibians. It is considered that suitable habitat is extremely widespread in the proposed development site and beyond. No likely significant effects on these species are anticipated and therefore these species are not included as KERs.
Marsh fritillary Local Importance (Higher Value)	*N*	This species was not recorded within the proposed development site during the dedicated surveys undertaken. Although small patches of devil's bit scabious (*Succisa pratensis*) were recorded throughout the development site, particularly in road verges, grassy access tracks, some areas of wet grassland and the edges of peatland habitat, no larval webs were recorded during the comprehensive search. It is considered that there will not be a significant loss of marsh fritillary habitat as a result of the proposed development and therefore marsh fritillary is not included as a KER.

7.5 Ecological Impact Assessment

7.5.1 Do Nothing Impact

The land that forms the proposed development site is dominated by commercial forestry plantations at various stages in the rotational cycle.

If the wind energy development for which this EIAR has been prepared does not go ahead, it is likely that the character of the environment and its uses will remain much as they are today. Should the proposed wind energy development proceed, it is likely that the main land-use of the area will effectively remain as commercial forestry, with wind energy generation being a land-use that is superimposed over the plantation during the lifetime of the proposed development.

7.5.2 Impacts during Construction

Effects on the key ecological receptors (KERs) as defined in the preceding sections, during the construction phase of the proposed development are described below in Tables 7.19-27.

7.5.2.1 Impacts on Habitats

The development footprint is dominated by habitats considered to be of low ecological value. 73.5% of the development footprint is located on habitats that are classified as Local importance (lower value). Such habitats include conifer plantation (WD4), Spoil and bare ground (ED2) and rush dominated or grazed wet grasslnd (GS4). These habitats have not been identified as KERs and although there will be loss of these habitats as a result of the proposed development, the loss is not conisdered to represent a significant effect at any geographic scale.

The loss, degradation or fragmentation of habitats that have been identified as Key Ecological Receptors to facilitate construction is described in the following sections.

7.5.2.2 Peatland Habitats

Table 7-19 Loss of Wet heath, Lowland blanket bog & Cutover bog habitat

Description of Effect	**Direct Effects** The proposed development has been designed to avoid the majority of the peatland habitats on the development site. The proposed wind farm development will result in the loss of approximately 0.3ha of degraded Wet Heath and Cutover Bog mosaic at the locations of T6 and along the proposed access track to T6. Both options for the cable route will pass through approximately 500m of peatland habitat (only one will be built). It will be capped off with a granular stone finish and thus the loss will be permanent. The finished cable route will be approximately 3m wide, thus the total loss of peatland habitat associated with the grid connection will be 0.15ha with an additional 0.04 ha lost if the proposed alternative route is followed. This would result in a maximum total loss of 0.49ha peatland habitat as a result of the propsed development. **Indirect Effects** Potential indirect effects on these habitats include drainage associated with the construction phase of the development. The effect will be restricted to the locations where these habitats will be lost. The effect will be localised and is not likely to have any effect on peatlands that are not immediately adjacent to the proposed infrastructure

Characterisation of unmitigated effect	The loss of approximatey 0.49ha (windfarm development site plus Booltiagh cable route, allowing for alternative grid connection route) of degraded peatland habitat within the development site constitutes a permanent, slight negative effect on a receptor of County Importance. The effect is characterised as slight because the development has been specifically designed to avoid peatland habitats where possible and impact on areas that are heavily altered through drainage, turf cutting and grazing. The proposed development will impact on approximately 1.5% of the peatland habitats that were identified within the development site. This effect is not reversible.
Assessment of Significance prior to mitigation	The permanent loss of up to 0.49ha of degraded peatland habitats is not significant at any geographic scale. This is because the development has been designed to avoid peatland habitats where possible and will only result in the loss of a small area of highly degraded and fragmented peatland mosaic. This will not affect the Conservation Status of this habitat, high quality examples of which are extensively represented in the wider area.
Mitigation	Whilst no significant loss of peatland habitats is predicted, a 'Hen harrier and Peatland Habitat Enhancement Plan' has been prepared for the proposed development which identifies an area of 28.2 ha of forestry on which to restore peatland habitats. This forestry has been planted on peatland habitats and the heath and bog is still the dominant ground flora. The proposed enhancement area is specifically designed for the provision of biodiversity gain in the form of enhancement of peatland habitats, which will provide additional habitat for hen harrier and other bird species.The works involve the felling of commercial forestry and the blocking of drains throughout the area to encourage peatland restoration. All felling works will be undertaken in full accordance with the Coillte standard operating procedures and forest guidelines. The proposed works are of a nature and scale that there is no potential for them to result in any significant adverse effect on biodiversity.The habitat enhancement plan is included in Appendix 8-8 of this EIAR. The plan follows the most relevant guidelines and provides details of the measures that will be undertaken to restore the peatlands along with a programme for the ongoing monitoring and reporting of the restoration.
Residual Effect following Mitigation	Mitigation includes the commitment to restore and enhance 28.2 hectares of peatland habitat that is currently under forestry and outside the construction footprint. This will result in an overall increase in peatland habitat resulting from the windfarm development. This is a **Long Term Slight Positive Effect.**
Potential for Cumulative Effect	The proposed development will not result in any permanent or long term loss of peatland habitats. It therefore cannot contribute to any cumulative effect in this regard.

7.5.2.3 Watercourses within and Downstream of the Development Site

Table 7-20Watercourses within and downstream of the development site

Description of Effect	**Direct Effects** The proposed development has been designed to ensure no loss of fisheries habitat or reduction in the suitability or availability of fish habitat. No instream works are proposed within the proposed development site or along the proposed grid conenction routes and no

	structures are proposed that will impede fish passage on any watercourse. The potential for direct effects on the receptor can be excluded. **Indirect Effects** Potential indirect effects include deterioration of surface water and habitat quality resulting from the run off of silt, hydrocarbons and other pollutants to surface water during the construction phase of the development.
Characterisation of unmitigated effect	The deterioration of surface water during construction would constitute a short term negative effect on this habitat. This effect is reversible as the rivers would likely recover following the completion of construction. No instream works are proposed and all major infrastructure is located over 50 metres from any watercourse. In addition, there are few significant watercourses on the site of the proposed development. As such, following the precautionary principle the magnitude of this potential effect is at highest moderate.
Assessment of Significance prior to mitigation	Following the precautionary principle, and in the absence of mitigation the proposed development has the potential to result in significant effects on the watercourses both within and downstream of the development site.
Mitigation	The proposed development has been designed to avoid all instream works and all large-scale infrastructure such as turbines, site compound and borrow pit are located as far from watercourses as possible. Watercourse crossings have been designed so that where possible, existing bridges are used and the number of new crossings is minimised. The drainage measures that are integral to the development are fully described in Chapters Ten and Four of this EIAR and in the CEMP provided in Appendix 4-4 of the EIAR and demonstrate how significant effects on watercourses will be avoided. A summary of the main measures is provided in Section 7.8.3 below.
Residual Effect following Mitigation	Post implementation of mitigation, no potential for significant effects is identified. The development does not have the potential to result in significant residual effects on this KER either at the National, County or Local level.
Potential for Cumulative Effect	The proposed development will not result in any significant deterioration of water quality of river habitats. It therefore cannot contribute to any cumulative effect in this regard

7.5.2.4 Impacts on Fauna

The effects of the proposed development on fauna during the construction phase of the development are considered in this section. Faunal species that have not been identified as KERs were considered but no potential for significant impacts at any geographic scale was identified.

Species identified as Key Ecological Receptors in the desk study include bats, otter and aquatic fauna.

7.5.2.4.1 *Bats*

Table 7-21 Impacts of construction phase on bats

Description of Effect	**Habitat Loss / degradation** Direct effects on bats are not anticipated. No sites suitable for maternity colonies, swarming or hibernation were identified. The occupied dwelling containing a bat roost will be retained as part of the development proposal.

	There will be no net loss of bat foraging or commuting or roosting habitat associated with the proposed development.
	Habitat Fragmentation There will be no significant fragmentation of bat foraging and commuting habitat associated with the proposed development.
	Disturbance Bats may be disturbed by increased human presence and increased noise during construction, leading to avoidance of the area. However, the proposed development site is not utilised by large populations of roosting bats. No sites suitable for maternity colonies, swarming or hibernation were identified. Bat activity levels were assessed as Moderate-High, however with a preference for woodland and edge habitats. In addition, construction works will be temporary. Significant disturbance effects are not anticipated.
Characterisation of unmitigated effect	**Habitat Loss** Long term netural effect/No effect
	Fragmentation Long term netural effect/No effect.
	Disturbance Taking a preacutionary approach the potential for disturbance of bats as a result of the construction activities is assessed as a short-term negative effect of slight magnitude.
Assessment of Significance prior to mitigation	**Habitat Loss** No signficant effect at any geographical scale is anticipated.
	Fragmentation No signficant effect at any geographical scale is anticipated.
	Disturbance In the absence of mitigation the effect is considered to be slight at a local scale. This is not considered to be significant at any geographic scale.
Mitigation	**Habitat Loss** No mitigation required
	Fragmentation No mitigation required

	Disturbance During the construction phase, noise limits, noise control measures, hours of operation and selection of plant items will be considered in relation to disturbance of bats. In addition, 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	**Habitat Loss** No significant effects are anticipated.
	Fragmentation No significant effects are anticipated.
	Disturbance No significant effects are anticipated.
Potential for Cumulative Effect	**Habitat Loss** The proposed development will not result in any significant effect in regard to habitat loss/degradation for bat species. It therefore cannot contribute to any cumulative effect in this regard.
	Fragmentation The proposed development will not result in any significant effect in regard to habitat fragmentation for bat species. It therefore cannot contribute to any cumulative effect in this regard.
	Disturbance The proposed development will not result in any significant effect in regard to disturbance for bat species. It therefore cannot contribute to any cumulative effect in this regard.

7.5.2.4.2 *Otter*

Table 7-22 Impacts of the construction phase on otter

Description of Effect	**Habitat Loss / degradation** No signs of otter were recorded within the proposed development site during the surveys undertaken. The watercourses on the site did not provide high quality habitat for this species. Direct effects on otter are not anticipated. Potential indirect effects may include deterioration of surface water and supporting habitat quality resulting from the run off of silt, hydrocarbons and other pollutants during the construction phase of the development.
	Habitat Fragmentation All major infrastructure associated with the proposed development is located over 50 metres from the watercourses on the site. No structures are proposed within the watercourses and no instream works are proposed. No potential for significant fragmentation of otter habitat is identified.
	Disturbance There is no evidence to suggest that the proposed development site supports a regularly occurring otter population and no otter breeding sites or holts were observed during the targeted surveys. Consequently significant disturbance is not anticipated. Following the precautionary principle, potential effects may include disturbance during daytime construction operations. However, given the design of the development (major infrastructure over 50m from any watercourse) and the short-term nature of the works, no potential for significant impacts on the species in terms of disturbance or displacement is anticipated.
Characterisation of unmitigated effect	**Habitat Loss/degradation** There will be no direct loss of otter habitat. In the absence of mitigation, indirect habitat degradation is assessed as a short term negative effect. Given the small number and size of the watercourses that provide connection to potential otter habitat and following the precautionary principle, the magnitude of this potential effect is at highest moderate. This potential effect is reversible as water quality would recover.
	Fragmentation No potential for significant fragmentation of otter habitat is identified.
	Disturbance No potential for significant fragmentation of otter habitat is identified.
Assessment of Significance prior to mitigation	**Habitat Loss** Following the precautionary principle and in the absence of mitigation, indirect loss of otter habitat has the potential to have a significant effect on populations of local importance in the wider catchment as a result of water pollution.
	Fragmentation No potential for significant fragmentation of otter habitat is identified.

	Disturbance No potential for significant fragmentation of otter habitat is identified.
Mitigation	**Habitat Loss / degradation** The proposed development has been designed to avoid all instream works and all large-scale infrastructure such as turbines, site compound and borrow pit are located as far from watercourses as possible. Watercourse crossings have been designed so that where possible, existing bridges are used and the number of new crossings is minimised. The drainage measures that are integral to the development and fully described in Chapters Four and Ten of this EIAR and in the CEMP provided in Appendix 4-4 of the EIAR demonstrate how significant effects on watercourses will be avoided. A summary of the main measures is provided in Section 7.8.3 below.
	Fragmentation None required
	Disturbance Disturbance limitation measures, will be adhered to, including the following measures: › All plant and equipment for use will comply with Statutory Instrument No 359 of 1996 "European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations 1996". › Plant machinery will be turned off when not in use. › Operating machinery will be restricted to the proposed works site area. › Construction works will be limited to daylight hours and artificial lighting to facilitate works will not be permitted.
Residual Effect following Mitigation	**Habitat Loss** – No significant effect
	Fragmentation – No significant effect
	Disturbance – No significant effect
Potential for Cumulative Effect	**Habitat Loss** The proposed development will not result in any significant effect in regard to habitat loss/degradation for otter. It therefore cannot contribute to any cumulative effect in this regard.
	Fragmentation The proposed development will not result in any significant effect in regard to habitat fragmentation for otter. It therefore cannot contribute to any cumulative effect in this regard.
	Disturbance The proposed development will not result in any significant effect in regard to habitat disturbance for otter. It therefore cannot contribute to any cumulative effect in this regard.

7.5.2.4.3 *Aquatic Fauna*

Table 7-23 Impacts on aquatic fauna

Description of Effect	**Habitat Loss / degradation** Direct habitat loss for Atlantic salmon, freshwater pearl mussel or other aquatic receptors is not anticipated. There are no instream works associated with the development. There will be no loss of fisheries habitat such as spawning gravels or nursery areas. Although the watercourses within the proposed development site do not provide significant habitat foraquatic fauna including Atlantic salmon, lamprey species, freshwater pearl mussel, brown trout and European eel, suitable habitat can be found in the watercourses downstream of the proposed development site including the Creegh and Annageeragh rivers. There is potential for habitat degradation for these species downstream as a result of deterioration of surface water and habitat quality resulting from the run off of silt, hydrocarbons and other pollutants to surface water during the construction phase of the development.
	Fragmentation No instream works are proposed and therefore there is no potential for the fragmentation or barriers to movement within the aquatic environment
	Disturbance Disturbance of aquatic species is not anticipated. There will be no instream works within the development site or along the proposed grid connection routes.
Characterisation of unmitigated effect	**Habitat Loss / degradation** In the absence of mitigation, indirect habitat degradation is assessed as a short term negative effect. Given the small number and size of the watercourses that provide connection to significant downstream habitat for aquatic species and following the precautionary principle, the magnitude of this potential effect is at highest moderate. This potential effect is reversible as water quality would recover.
	Disturbance No significant effect anticipated
Assessment of Significance prior to mitigation	**Habitat Loss / degradation** In the absence of mitigation, indirect efffetcs due to deterioration of surface water have the potential to be significant at the local scale.
	Disturbance No significant effect anticipated
Mitigation	**Habitat Loss / degradation** The proposed development has been designed to avoid all instream works and so that all large-scale infrastructure such as turbines, site compound and borrow pit are located as far from watercourses as possible. Watercourse crossings have been designed so that where possible, existing bridges are used and the number of new crossings is minimised. The drainage measures that are integral to the development and fully described in Chapters Four and Ten of this EIAR and in the CEMP provided in Appendix 4-4 of the

	EIAR demonstrate how significant effects on watercourses will be avoided. A summary of the main measures is provided in Section 7.8.3 below.
	Disturbance None required
Residual Effect following Mitigation	**Habitat Loss / degradation** Post implementation of mitigation, the potential for effects on this receptor is limited to a Potential Long Term Not Significant effect. The development does not have the potential to result in significant residual effects on this KER either at the National, County or Local level.
	Disturbance No significant effect
Potential for Cumulative Effect	**Habitat Loss** The proposed development will not result in any significant effect in regard to habitat loss/degradation for aquatic species. It therefore cannot contribute to any cumulative effect in this regard.
	Disturbance The proposed development will not result in any significant effect in regard to disturbance of aquatic species. It therefore cannot contribute to any cumulative effect in this regard.

7.5.3 Operational Phase

7.5.3.1 Impacts on Habitats

There will be no additional loss of any habitats associated with the operational phase of the development. There is potential for ongoing drainage effects on areas of peatland habitat adjacent to areas where peatland habitat will be lost during construction. Operational effects include the same potential drainage impacts as were associated with the construction but have the potential to be long term in nature. The effect is assessed as a **Long-term Slight Negative Effect.**

7.5.3.1.1 Peatland Habitats

Table 7-24 Impacts on peatland habitats during the operational phase

Description of Effect	There is potential for ongoing drainage effects on areas of peatland habitat adjacent to areas where peatland will be lost during construction. Operational effects include the same potential drainage impacts as were associated with the construction but have the potential to be long term in nature.
Characterisation of unmitigated effect	This is a Long-term Negative effect. The efffect is reversible through appropriate mitigation and design. Given that the effect is only likely to affect the area immediately adjacent to the infrastructure in habitats that are already highly degraded through drainage, grazing and scrub encroachment, this effect is negligible.
Assessment of Significance prior to mitigation	No significant effect anticipated
Mitigation	Whilst no significant loss of peatland habitats is predicted, a 'Hen harrier and Peatland Habitat Enhancement Plan' has been prepared for the proposed development which identifies an area of 28.2 ha of forestry on which to restore peatland habitats. This forestry has been planted on peatland habitats and the heath and bog is still the dominant ground flora. The proposed enhancement area is specifically designed for the provision of biodiversity gain in the form of enhancement of peatland habitats, which will provide additional habitat for bird species including hen harrier and other species.The works involve the felling of commercial forestry and the blocking of drains throughout the area to encourage peatland restoration. All felling works will be undertaken in full accordance with the Coillte standard operating procedures and forest guidelines. The proposed works are of a nature and scale that there is no potential for them to result in any significant adverse effect on biodiversity. The habitat enhancement plan is included in Appendix 8-8 of this EIAR. The plan follows the most relevant guidelines and provides details of the measures that will be undertaken to restore the peatlands along with a programme for the ongoing monitoring and reporting of the restoration.
Residual Effect following Mitigation	Mitigation includes the commitment to restore and enhance 28.2 hectares of peatland habitat that is currently under forestry and outside the construction footprint. This will result in an overall increase in peatland habitat resulting from the windfarm development. This is a **Long Term Slight Positive Effect**
Potential for Cumulative Effect	The proposed development will not result in any significant effect in regard to residual effects on peatland habitts. It therefore cannot contribute to any cumulative effect in this regard.

7.5.3.1.2 Watercourses within and Downstream of the Development Site

Table 7-25 Impacts on watercourses during the operational phase

Description of Effect	Potential indirect effects may include deterioration of surface water and habitat quality resulting from the run off of silt and other pollutants from hard standing areas and wind farm drainage during the operation of the development. The potential for pollution of watercourses is far lower during the operational phase due to the lack of earth moving and construction activity.
Characterisation of unmitigated effect	Long-term Negative effect. The effect is reversible through appropriate mitigation and design. Whilst there are no large-scale earthworks associated with operational phase, faster run off water from hardstands could potentially result in an impact of moderate magnitude.
Assessment of Significance prior to mitigation	Following the precautionary principle, this impact has the potential to be significant at the local scale.
Mitigation	The proposed development includes a detailed drainage plan that is included in full in Chapters Four and Ten of the EIAR. This plan and all the associated measures have been taken into account in this assessment but are not included in full in this chapter (to avoid repetition). The drainage philosophy overall is to minimise waters arising on site, to adequately treat any water that may arise and to ensure that the hydrological function of the watercourses on the site and in the wider catchment are not affected by the proposed works.
Residual Effect following Mitigation	Significant effects are not anticipated following the implementation of mitigation.
Potential for Cumulative Effect	The proposed development will not result in any significant effect in regard to deterioration of watercourses. It therefore cannot contribute to any cumulative effect in this regard.

7.5.3.2 Impacts on Fauna

The operational phase effects on faunal species that have been identified as Key Ecological Receptors to facilitate construction are described in the following sections.

7.5.3.2.1 Bats

Table 7-26 Impacts on bats during opertional phase

Description of Effect	**Disturbance/Displacement** Bats may be disturbed by noise and/or movement of operational wind turbines, leading to avoidance of the area. However, the proposed development site is not utilised by large populations of bats. It is unlikely there will be any significant disturbance or displacement during the operational phase.
	Mortality Death may occur through collision with turbine blades or as a result of barotrauma. Significant fatalities may negatively affect local and national bat populations.

	To date, no studies have conclusively linked pre-construction activity surveys to post-construction fatality rates (Hein et al. 2013). However, there is a strong positive correlation between post-construction activity and fatality at wind farms (Kunz et al. 2007, Baerwald and Barclay 2009, Amorim et al. 2012, Korner-Nievergelt et al. 2013). Median bat activity peaked at ***Moderate*** for Leisler's bat, *Myotis* sp. and brown long-eared bat for at least one season. Median activity levels for common and soprano pipistrelle peaked at ***Moderate to High*** for at least one season. Lesser horseshoe bat recorded ***Low*** median bat activity in spring. Maximum activity levels peaked with ***High*** activity for all species for at least one season except Lesser horseshoe bat activity which was ***Low***. In addition, bat activity at height (within the potential risk zone) was significantly less than that at ground level with only 13passes of *Myotis spp.* recorded. Therefore, provided there is no significant change in activity as a result of the proposed development, there is some potential for negative effects. Post-construction activity monitoring and fatality searches will be undertaken to monitor any changes. All other recorded species are low collision risk species and no negative effect arising from collisions is predicted. Wind turbines located close to roosts present a greater risk of collision. Proposed turbine locations are located at least 400m from the one identified roost within the development site. Therefore, no increased risk of collision is anticipated due to proximity to roost sites.
Characterisation of unmitigated effect	In the absence of mitigation, the risk of mortality for species at high risk of collision, i.e. soprano,common pipistrelle and Leisler's bat is assessed as a Long term slight negative effect. No negative effects as a result of mortality are expected for any other bat species which are considered to be at low risk of collision.
Assessment of Significance prior to mitigation	Following the precautionary principle and in the absence of mitigation, the risk of mortality for species at high risk of collision, i.e. soprano, common pipistrelle and leisler's bat has the potential to be a significant effect.
Mitigation	A 50m buffer from the blade tip to the nearest woodland, as recommended by the Natural England (2014) and SNH (2019) guidelines, shall be implemented in advance of commissioning of the wind farm. These vegetation-free areas will be maintained during the operational life of the development. This will significantly alter the baseline environment and minimise the potential for bat collisions. Following the precautionary principle and in accordance with the SNH (2019) guidelines, any future operation of the wind farm will also be the subject of ongoing monitoring as described in Appendix 7-2. If, following monitoring, there is any uncertainty as to the impacts on bat species, additional mitigation will be implemented. The mitigation that could potentially be applied is described below in Section 7.5.8.
Residual Effect following Mitigation	No significant effects are likely to occur as a result of the operation of the wind farm and if, following monitoring of any future operation, mitigation is required, it will be employed to ensure that there are no significant effects on bat species.
Potential for Cumulative Effect	The proposed development will not result in any significant effect with regard to bat species. It therefore cannot contribute to any cumulative effect in this regard.

7.5.3.3 Otter, freshwater pearl mussel & other aquatic species

Table 7-27 Impacts on otter and other aquatic fauna during operational phase

Description of Effect	Potential indirect effects may include deterioration of surface water and habitat quality resulting from the run off of silt and other pollutants from hard standing areas and wind farm drainage during the operation of the development. The potential for pollution of watercourses is far lower during the operational phase due to the lack of earth moving and construction activity.
Characterisation of unmitigated effect	Long-term Negative effect. The efffect is reversible through appropriate mitigation and design. Whilst there are no large-scale earthworks associated with the operational phase, faster run off water from hardstands could potentially result in an impact of moderate magnitude.
Assessment of Significance prior to mitigation	Following the precautionary principle, this impact has the potential to be significant at the local scale.
Mitigation	The proposed development includes a detailed drainage plan that is included in full in Chapters 4 and 10 of the EIAR. This plan and all the associated measures have been taken into account in this assessment but are not included in full in this chapter (to avoid repetition). The drainage philosophy overall is to minimise waters arising on site, to adequately treat any water that may arise and to ensure that there is no significant effect on the water quality that is the habitat of sensitive aquatic species.
Residual Effect following Mitigation	Significant effects are not anticipated following the implementation of mitigation
Potential for Cumulative Effect	The proposed development will not result in any significant effect in regard to deterioration of aquatic fauna. It therefore cannot contribute to any cumulative effect in this regard.

7.5.4 Impacts During Decommissioning

Decommissioning is fully described in Chapter 4 but would involve primarily the removal of the above ground elements of the turbines, with the foundations left in-situ and covered with soil (thus avoiding large scale excavations). The existing site roads would be used during decommissioning. The redundant Grid Connection cables will be pulled from their trenches without the requirement for significant excavation.

Whilst the works required to decommission the wind farm will be considerably smaller in scale than those required for construction, they will be similar in nature (though without large scale excavation or use of concrete. The impacts on biodiversity will also be similar in nature to those experienced during construction but on a far lesser scale and magnitude.

As with construction, a suite of measures is in place to avoid any significant effects on biodiversity. These measures are set out throughout the EIAR and in the CEMP as provided in Appendix 4-4 of the EIAR. These measures will be employed in full during any works associated with the decommissioning of the subject development at any stage. The decommissioning phase of the development will be overseen and supervised by an ECoW to ensure that the prescribed measures are fully and correctly implemented. It can be concluded that following the implementation of preventative mitigation, there is no potential for the decommissioning of the windfarm to result in significant effects on biodiversity.

7.5.5 Invasive Species

Invasive species recorded on site were restricted to stands of Rhododendron along the proposed cable route options. No evidence of other species such as Japanese knotweed or Himalayan balsam were recorded within the proposed development site. However, legislative requirements should be considered to control the spread of noxious weeds and non-native invasive plant species. It is important that any activities associated with the planning, construction and operation of wind farm developments comply with the requirements of the Wildlife Acts, 1976-2012 (as amended). Regulations 49 and 50 of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2015) include legislative measures to deal with the dispersal and introduction of Invasive Alien Species (IAS), which are listed in the Third Schedule of the regulations.

The introduction and/or spread of invasive species such as Himalayan balsam, giant rhubarb or Rhododendron for example, could result in the establishment of invasive alien species and this may have negative effects on the surrounding environs.

A Rhododendron Management Plan has been prepared as part of the proposal and is provided in full in Appendix 7-4. This describes the measures required to control the spread of Rhododendron during the construction phase of the proposal. The recorded distribution of Rhododendron within and adjacent to the proposed infrastructure footprint is illustrated in Figure 7.8.

The requirements of the Rhododendron Management Plan will be implemented in full during the construction phase of the proposal and the control measures are also referred to in Mitigation Measure MM44 in the Table in Section 6 of the CEMP which is provided in Appendix 4-4 to this EIAR.

7.5.6 Assessment of any Biodiversity or Ecological Gains

A habitat enhancement plan has been prepared for the proposed development, which identifies an area of 28.2 ha of forestry on which to restore peatland habitats. This forestry has been planted on peatland habitats and the heath and bog is still the dominant ground flora. The proposed enhancement area is specifically designed for the provision of biodiversity gain in the form of enhancement of peatland habitats, which will provide additional habitat for bird species including hen harrier and other species.The works involve the felling of commercial forestry and the blocking of drains throughout the area to encourage peatland restoration. All felling works will be undertaken in full accordance with the Coillte standard operating procedures and forest guidelines. The proposed works are of a nature and scale that there is no potential for them to result in any significant adverse effect on biodiversity. The habitat enhancement plan is included in Appendix 8-8 of this EIAR and will be undertaken in accordance with the published guidelines and best practice such as the guidelines arising from the EU–LIFE/Coillte 'Irish Blanket Bog Restoration Project" (2002-2007)', Scottish Natural Heritage (SNH)'s guidance note Planning for development: What to consider and include in Habitat Management Plans (Version 2, January 2014).

The restoration and enhancement of 28.2 hectares of peatland will result in an overall increase in peatland habitat resulting from the windfarm development. This is a **Long Term Slight Positive Effect.** It also ties in with a number of principles and actions outlined in the National Peatlands Strategy (NPWS, 2015), which aims to provide a long-term framework within which all of the peatlands within the State can be managed responsibly in order to optimise their social, environmental and economic contribution to the well-being of this and future generations, including the following:

- Principle 11: The Department of Agriculture, Food and the Marine and other relevant authorities will aim to ensure that forestry measures and management plans protect peatland habitats and associated species, as appropriate.
- Principle 17: In deciding on the most appropriate afteruse of cutaway peatlands, consideration shall be given to encouraging, where possible, the return to a natural

functioning peatland ecosystem. This will require re-wetting of the cutaway peatlands which may lead in time to the restoration of the peatland ecosystem.

- Principle 24 : Coillte and Born na Móna as the managers of significant tracts of peatlands on bealf of the Irish people will continue to show leadership in responsible management, rehabilitation and restoration of peatlands
- Action 12: The work of Bord na Móna, Coillte and the Irish Peatlands Conservation Council in developing ecologically rich futures for cutaway and formerly forested bogs will be developed. Such areas can bring new tourism and recreation attractions to the midlands and the west.

7.5.7 Impacts on Designated Sites

7.5.7.1 Impacts on European Sites

The EPA draft Guidance 2017 states:

> *"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 Article 6(3) Appropriate Assessment Screening report identified the potential for the proposed development to result in significant effects due to deterioration of water quality on the following European Sites:

- Carrowmore Point to Spanish Point and Islands SAC (001021)
- Carrowmore Dunes SAC (002250)
- Mid-Clare Coast SPA (004182)

The potential for impact on European sites has been fully assessed in the Appropriate Assessment Screening Report (AASR)/NIS that has been prepared in support of the current application.

The NIS concludes as follows:

> "*Where the potential for any adverse effect on any European Site has been identified, the pathway by which any such effect may occur has been robustly blocked through the use of avoidance, appropriate design and mitigation measures as set out within this report and its appendices. The measures ensure that the construction and operation of the Proposed Development does not adversely affect the integrity of European sites*
>
> *Therefore, 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*".

7.5.7.2 Impacts on Nationally Designated Sites

Impacts on nationally designated sites including NHAs and pNHAs are considered in this section of the report.

Where such sites are also designated as SACs or SPAs (European Sites) the potential pathway for effect is the same and the measures that are in place to avoid any effects are also in place. In this case, the following pNHAs are also designated as the SACs and/or SPAs considered above:

- Carrowmore Point to Spanish Islands pNHA
- White Strand/Carrowmore Marsh pNHA

The potential for significant effects on these Nationally Designated Sites was considered and it was found that the only potential pathway for effect was via water deterioration. This pathway has been robustly blocked through measures to prevent water pollution during construction, operation and decommissioning. These measures are fully described in Chapters 4 and 10 and in the CEMP and summarized below.

The northern boundary of Cragnashingaun Bog NHA occurs adjacent to the proposed grid connection route. The northern boundary of the NHA occurs along a forestry track associated with the adjacent conifer plantation. The grid connection will be restricted to this disturbed habitat and will not encroach on blanket bog habitat within the NHA. Consequently there is no potential for impact on the NHA. The only Nationally designated site that is not also designated as an SAC or SPA and where a potential pathway for effects exists is the White Strand/Carrowmore Marsh pNHA. This is located 6.1km from the site of the proposed development and is hydrologically connected via the Creegh and Skivileen Rivers. The only pathway by which significant effects may occur is via deterioration of surface water in the Creegh River.

Measures are in place during construction, operation and decommissioning to ensure that any pathway for significant effect on the Creegh River and therefore other downstream receptors such as the pNHA are effectively blocked.

The proposed development has been designed to avoid all instream works and all large-scale infrastructure such as turbines, site compound and borrow pit are located as far from watercourses as possible. Watercourse crossings have been designed so that where possible, existing bridges are used and the number of new crossings is minimised.

The drainage measures that are integral to the development and fully described in Chapter Four of this EIAR and in the CEMP shown in Appendix 4-4 of the EIAR demonstrate how significant effects on watercourses will be avoided. A summary of the main measures is provided in Section 7.8.3 below.

Following the implementation of mitigation, there is no potential for the proposed development to result in significant effects on any Nationally Designated Site.

7.5.8 Summary of Main Mitigation Measures

7.5.8.1 Summary of Water Protection Measures

The proposed development has been designed so that all large-scale infrastructure such as turbines, site compound and borrow pit are located as far from watercourses as possible and so that water crossings that occur on access tracks etc. are minimised and where possible, use existing bridges. The best practice construction measures described below are designed to avoid impacts on areas that are outside the site including watercourses.

- A Construction and Environmental Management Plan (CEMP) has been prepared, and is included as Appendix 4-4 of the EIAR. The CEMP will be in place prior to the start of the construction phase.
- Machinery and materials will either be parked/stored in the specified compound areas. Wherever possible, vehicles will be refuelled off-site. This will be the case for regular, road-going vehicles.
- For construction machinery that will be based on-site continuously, a limited amount of fuel will have to be stored on site.
- On-site refuelling of machinery will be carried out using a mobile double skinned fuel bowser.

- The fuel bowser, a double-axle custom-built refuelling trailer will be refilled off site, and will be towed around the site by a four-wheel drive 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 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.
- Refuelling operations will be carried out only by designated trained and competent operatives.
- Mobile anti-pollution measures such as drip trays and fuel absorbent mats will be used during all refuelling operations.
- Materials excavated (e.g. peat, soil, gravel or rock) during construction of the turbine bases, electrical sub-station, or during construction of new roadways or the upgrading works on existing roadways will be reused within the site.
- Re-use of these materials within the site will occur under conditions where there is no possibility of the material becoming mobile in the environment and entering into either surface or ground waters.
- The CEMP also provides for the appointment of a Site Supervisor/Construction Manager and/or Environmental Manager to maintain responsibility for monitoring the works and Contractors/Sub-contractors from an environmental perspective. In addition, a Project Ecologist, Project Hydrologist and Project Geotechnical engineer will visit the site regularly and report to the Site Environmental Office. This structure will provide a "triple lock" review/interaction by external specialists during the construction phase.

In addition, the proposed development includes a detailed drainage plan that is included in full in Chapters 4 and 10 of the EIAR. This plan and all the associated measures have been taken into account in this assessment but are not included in full in this chapter (to avoid repetition). The drainage philosophy overall is to minimise waters arising on site, to adequately treat any water that may arise and to ensure that the hydrological function of the watercourses on the site and in the wider catchment are not affected by the proposed works. This philosophy, including all associated mitigation measures to protect local surface water quality, is fully described in Chapter 4 (Description of the Proposed Development) and Chapter 10 (Hydrology & Hydrogeology) of this EIAR. Further details are also provided in the CEMP in Appendix 4-4 of Chapter 4 of the EIAR.

The NRA Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes and the Scottish Natural Heritage (SNH) Good Practice During Wind Farm Construction will also be adhered to.

7.5.8.2 Summary of Bat Mitigation

7.5.8.2.1 *Noise Restrictions*

During the construction phase, 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).

7.5.8.2.2 *Lighting restrictions*

Where lighting is required, directional lighting will be used to prevent overspill on to woodland/forestry edges. This will be achieved using lighting accessories, such as hoods, cowls, louvers and shields, to direct the light to the intended area only.

7.5.8.2.3 *Buffering*

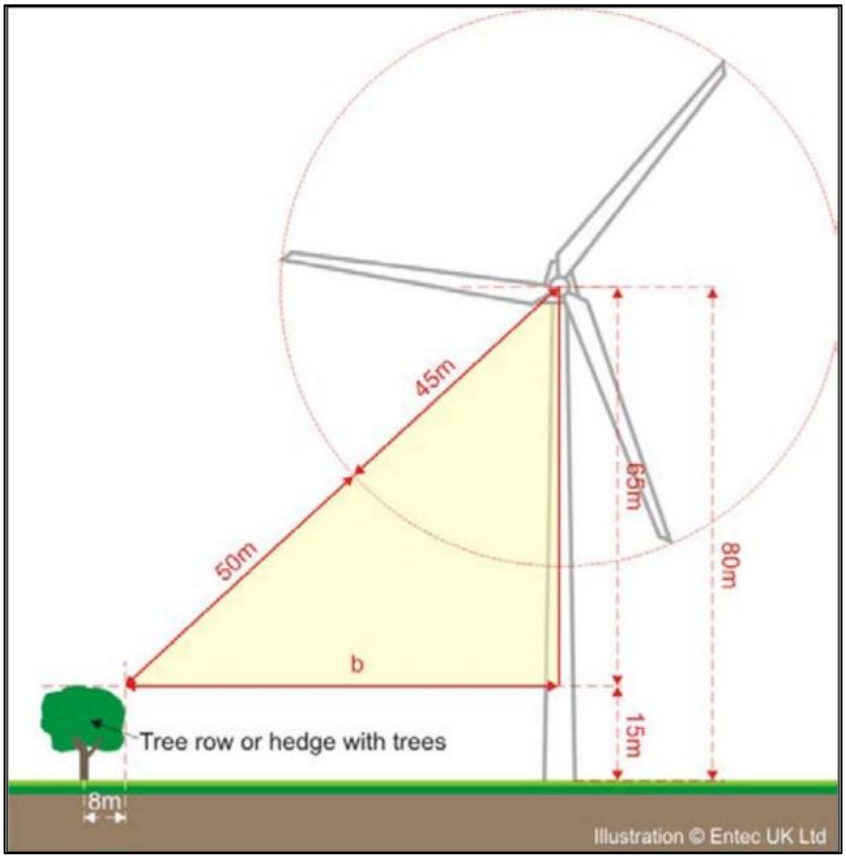
A 50m buffer from the blade tip to the nearest woodland, as recommended by the Natural England (2014) and SNH (2019) guidelines, shall be implemented. These vegetation-free areas will be maintained during the operational life of the development.

The correct buffer distance must be measured from the blade tip sweep to the canopy of the nearest habitat feature. Measuring 50m for the base of the turbine to the habitat feature is inadequate as tall tree canopies may put bat populations at risk. It is necessary to calculate the distance between the edge of the habitat feature and the centre of the tower (b). Using the formula:

$$b = \sqrt{(50 + bl)^2 - (hh - fh)^2}$$

Where, **bl** =Blade length, **hh** = hub height, **fh** = feature height all in metres.

E.g. (below) **b** = 69.3m (Plate 6-1)



7.5.8.3 Site Specific Mitigation and Monitoring Programme

Overall risk levels for high collision risk bat species was typically ***Medium***. This risk level is reflective of the nature of the site, which is an upland commercial conifer plantation with low levels of bat activity recorded during the walked transects undertaken.

However, taking a precautionary approach and given that high collision risk was recorded at peak activity levels, an adaptive monitoring and mitigation strategy has been devised for the proposed development in line with the case study example provided in Appendix 5 of the SNH Guidance.

7.5.8.3.1 *Post Construction Monitoring and Assessment of Adaptive Mitigation Requirement*

As per SNH Guidance at least 3 years of post-construction monitoring is required to assess the effects of construction related habitat modification on bat activity. For example, it may be that the construction of wind turbines significantly reduces bat activity at the site relative to that recorded pre-construction and to a level at which there is no longer potential for significant effects on bats (SNH 2019). Therefore, the results of post construction monitoring shall be utilised to assess changes in bat activity patterns and to inform the design of any advanced site specified mitigation requirements, including curtailment, to ensure that there are no significant residual effects on bat species.

7.6 Cumulative Impact Assessment

The potential for the proposed works to contribute to a cumulative impact Biodiversity was considered.

A number of other relevant projects have also been considered in this assessment and are provided in Table 7-2828 below.

7.6.1 Plans

Table 7-28 Review of Plans and Policies

Plans	Key Policies/Issues/Objectives Directly Related To European Sites, Biodiversity and Sustainable Development In The Zone of Influence	Assessment of development compliance with policy
Clare County Development Plan 2017-2023 and all associated environmental documents'	The County Council have a number of objectives relating to the protection, conservation and restoration natural heritage sites including specific objectives relating to the Natura 2000 network in Objective B2. It is an objective of the plan to protect European sites that form part of the Natura 2000 network and for proposed developments to pose no loss of protected habitats and species during the lifetime of the Plan. The no./percentage of developments in/near Natura 2000 network is to be monitored and recorded kept on the percentage of qualifying interest features which have achieved their specific objectives of maintenance or restoration. It is the policy of the Council to facilitate new development with no compromise in the favourable conservation condition of European sites. No compromise or impact on the achievement of the favourable conservation condition objectives (whether maintain or restore) of European sites. Designation of additional areas due to biodiversity and/or geological value. Percentage of unique habitats and species lost in designated sites through trending of annual surveys. **Natural Heritage and Biodiversity Policies and Objectives** **Objective CDP11.2** – It is an objective of the Development Plan: To support and implement the interjurisdictional Strategic Integrated Framework Plan (SIFP) for the Shannon Estuary in conjunction with the other relevant local authorities and agencies. All proposed developments shall be in accordance with the Birds and Habitats Directive, Water Framework Directive and all other relevant EU Directives. All proposed developments shall incorporate the Mitigation Measures as contained in the SIFP – Volume 7 of this Plan - for ensuring the integrity of the Natura 2000 Network;	The Development plan was comprehensively reviewed, with particular reference to Policies and Objectives that relate to the Natura 2000 network and other natural heritage interests. No potential for cumulative impacts were identified in conjunction with the current proposed development.

Plans	Key Policies/Issues/Objectives Directly Related To European Sites, Biodiversity and Sustainable Development In The Zone of Influence	Assessment of development compliance with policy
	Objective CDP11.5 – It is an objective of Clare County Council: To facilitate and promote the sustainable development of the lands at Strategic Development Location A – Innismurry / Cahiracon (as per Map 11A) for marine-related industry. All proposed developments shall be in accordance with the Birds and Habitats Directive,Water Framework Directive and all other relevant EU Directives;All proposed development at SDL A shall incorporate the Mitigation Measures as contained in the SIFP – Volume 7 of this Plan - for ensuring the integrity of the Natura 2000 Network. **Objective CDP11.6** – It is an objective of Clare County Council: a To safeguard the role and function of Strategic Development Location B –Moneypoint (as per Map 11B) as a key strategic driver of economic growth in the country, facilitating its sustainable growth, operational expansion and diversification, in accordance with national and regional energy objectives – ensuring in particular that all such developments shall not adversely affect species and habitats designated by the Habitats Directive; b To support and facilitate the development of marine-related industry on lands adjacent to Moneypoint which is compatible with the primary use of the SDL as a Strategic Energy Location. All proposed developments shall be in accordance with the Birds and Habitats Directive, Water Framework Directive and all other relevant EU Directives. All proposed development at SDL B shall incorporate the Mitigation Measures as contained in the SIFP – Volume 7 of this Plan - for ensuring the integrity of the Natura 2000 Network. **Objective CDP11.8** - It is an objective of Clare County Council: a To ensure that the Shannon Estuary fulfils it optimum role in contributing to the diversity and security of energy supply; b To harness the potential of the estuary for the sustainable development of renewable energy sources to assist in meeting renewable energy targets. All proposed developments shall be in accordance with the Birds and Habitats Directive, Water Framework Directive and all other relevant EU Directives. All development associated with the energy sector shall incorporate the sector and site specific Mitigation Measures as contained in the SIFP – Volume 7 of this Plan - for ensuring the integrity of the Natura 2000 Network.	

Plans	Key Policies/Issues/Objectives Directly Related To European Sites, Biodiversity and Sustainable Development In The Zone of Influence	Assessment of development compliance with policy
	Objective CDP3.15 - It is an objective of the Development Plan: To permit applications for the refurbishment of derelict dwellings/structures in the countryside subject to the following criteria: • The external walls are substantially intact and are capable of being refurbished; • The design of the proposed development does not erode the siting and design qualities of the dwelling/ structure. • The size of any extension takes account of the siting and size of the existing dwelling/ structure. • The design, scale and materials used in the refurbishment and/or extension are in keeping and sympathetic with the existing structure. • Mature landscape features are retained and enhanced, as appropriate. • That normal planning considerations i.e. road safety, amenities, public health, design, protected species (especially Lesser Horseshoe Bats and other bat species) etc. shall take precedence over the 'principle' of encouraging such development, and in particular that for such developments alongside or directly accessed from National Roads, the provisions of Objective CDP 8.4 shall apply (Refer to Chapter 8 Physical Infrastructure). In such circumstances where these sites occur in 'Areas of Special Control' the provisions of Objective CDP 3.11 (i.e. 'Local Need' requirement) will not apply except where the total or substantial demolition of the existing structure and a new dwelling is proposed. **Objective CDP4.15** - It is an objective of the Development Plan: To ensure that green areas associated with new residential developments enrich the quality of life of local residents and provide ecologically rich areas that enhance biodiversity and contribute to the green infrastructure network in the County. **Objective CDP9.13** - It is an objective of the Development Plan: To support the development of tourism activities in lakeland areas and waterways subject to normal planning and environmental criteria. All proposed developments shall be in accordance with the Birds and Habitats Directive, Water Framework Directive and all other relevant EU Directives.	

Plans	Key Policies/Issues/Objectives Directly Related To European Sites, Biodiversity and Sustainable Development In The Zone of Influence	Assessment of development compliance with policy
	Objective CDP10.9 -It is an objective of the Development Plan: a To promote and encourage state and private afforestation and reforestation throughout the countryside in appropriate locations, in compliance with Objective CDP2.1, and on suitable soil types as a means of promoting rural diversity and strengthening both the rural and urban economy; b To support the development of enterprises ancillary to the forestry industry, in particular value-improvement enterprises relating to timber extracted from County Clare forests; c To encourage the sustainable development of native woodlands to enhance biodiversity, the landscape and recreational amenity, to provide climate change mitigation and an education resource and to strengthen the rural economy.	
Clare Biodiversity Action Plan 2017-2023 and all associated environmental documents'	Relevant objectives of the Clare Biodiversity Action Plan include: › To ensure the Clare County Biodiversity Action Plan 2017-2023 fully informs all planning policy within the County, including the biodiversity objectives in the Clare County Development Plan 2017-2023 › Promote the retention and conservation of existing trees and hedgerows, and to prevent the disruption of connectivity between woodlands, hedgerows and other valuable habitats; › Continue to raise awareness of bats in County Clare and the importance of hedgerows as wildlife corridors; In addition, the following were identified as key threats to biodiversity: › Fragmentation of Habitats and Loss of Wildlife Corridors.	The biodiversity action plan was comprehensively reviewed, with particular reference to Policies and Objectives that relate to the Natura 2000 network and other natural heritage interests. No potential for cumulative impacts were identified in conjunction with the current proposed development.

Plans	Key Policies/Issues/Objectives Directly Related To European Sites, Biodiversity and Sustainable Development In The Zone of Influence	Assessment of development compliance with policy
	› Potential impacts from developments can be minimised, or even avoided, when the local biodiversity is taken into account at the earliest stages of project planning. › Water Pollution and Changes to Hydrology › Spread of Invasive Species Disturbance to Species	

7.7 Other Projects

A search of the online planning register has revealed that there have been no planning applications within the application boundary.

The wind farm applications set out in Table 7-29 below have occurred within a 20km radius of the application site.

Table 7-29 Planning History – Vicinity of Application Site

Planning Ref.	Site Name	Summary Description	Decision
00/567	Booltiagh Wind Farm Extension	A wind farm of 26 wind turbines with towers not exceeding 60 metres in height and rotor diameter not exceeding 62 metres and ancillary equipment for generation of electricity and control building and monitoring mast. Located circa 6-8km to the east of the application site. Operational	Granted on Appeal ref: PL.03. 120616 08/03/2001
00/952	Monamore Wind Farm	Seven turbines with a tip height of 98m, and all associated works. Located circa 12km to the south-west of the application site. Operational	Granted on Appeal ref: PL0.123292 19/11/2001
02/2228	Glenmore Wind Farm	For the construction of a wind farm consisting of 14 Wind turbines (75 metres hub height and 75 metres hub height and 80 metres rotor blade diameter), on-site tracks, sub station control compound, hard standing area and ancillary facilities and sub-terrain cabling Located circa 5-6km to the south-east of the application site. Later Amended consent at this location (Pl. Ref. 14/575 ; Partially Complete/ Under Construction	Granted by Clare County Council on the 29/06/2004
03/79	Hibernian Wind Power Limited	Nineteen wind turbines, each having a rated electrical output of approximately 2000 kilowatts, and all associated works. Each wind turbine will comprise a tower up	Clare County Council granted permission on the 13/11/2003

Planning Ref.	Site Name	Summary Description	Decision
		to 67 metres high, with blade lengths of up to 40 metres. Located circa 12km east of the application site. Under construction under applications 09/479 and 13/681	
03/80	Lissycasey Wind Farm	Ten wind turbines, each having a rated electrical output of approximately 2000 kilowatts, and all associated works. Each wind turbine will comprise a tower up to 67 metres high, with blades of up to 40 metres length Located circa 4.5km south-east of the application site. Not constructed	Clare County Council and An Bord Pleanála granted permission on the 04/12/2003
07/2900	Booltiagh Wind Farm	Permission for the erection of six wind turbines with a total tip height of up to 120 metres and all ancillary equipment and works. Located circa 6-8km to the east of the application site. Operational	Granted 17/10/2008
08/1678	Booltiagh Wind Farm	For Modification of Condition 2 of permitted development P07/2900. Permission for an extension of the permitted lifetime of the six turbine wind farm and ancillary equipment to a twenty year operational lifetime from the date of commissioning. Located circa 6-8km to the east of the application site. Operational	Granted by Clare County Council on the 24/01/2009
09/123	Crossmore Wind Farm	A development of seven wind turbines with hub height of 80m and blade diameter of 90m, construction of access roads, substation and associated works. Located circa 9km to the south/south-west of the application site. Permitted ; not yet constructed	Granted, 22.11.2009; EoD granted 10/07/2019 (ref: 19/388)

Planning Ref.	Site Name	Summary Description	Decision
09/358	Kiltumper Wind Farm	Two wind turbines with a hub height of 63m and rotor diameter of 70m, and all associated and ancillary works. Located to the south of the application site. Under Construction	Granted on Appeal ref: PL03.234010 20/10/2010
09/479	Boolynagleragh Wind Farm	11 wind turbines, with a hub height of up to 80m and blade length of up to 45m and all associated site infrastructure. Located circa 12km to the east of the application site. Operational	Granted on Appeal ref: PL03.236376 07/12/2010
10/9	Slieve Callan Wind Farm	The construction of a 29 turbine wind farm. turbines described as having a hub height of 80 metres and rotor diameter of 90 metres, and all associated site infrastructure works. Located circa 8-10km to the north/northeast of the application site. Operational	Granted on Appeal ref: Pl03.237524 on the 18/08/2011
10/64	Tullabrack Wind Farm	Six turbines with an overall height of up to 120.5m and all associated works. Located circa 12km to the south-west of the application site. Permitted; not yet constructed	Granted 17/06/2010
11/360 & PL03.239378	Letteragh Wind Farm	Six wind turbines, with a hub height of 85 metres and rotor diameter of 82 metres, and all ancillary works. Located circa 6km north-east of the application site. Operational	Clare County Council refused permission which was overturned and granted by An Bord Pleanála on 06/09/2011.
11/361 & Pl.03.239933	Letteragh Wind Farm	A development of six wind turbines (maximum hub height 90m, maximum blade diameter 93m), and all associated site infrastructure.	Granted 21/02/2013,

Planning Ref.	Site Name	Summary Description	Decision
		Located circa 9-11km to the east of the application site. Operational	
12/74	Moneypoint Genrating Station	Five turbines with a tip height of 125m, including all associated works. Located circa 18km to the south-west of the application site. Operational	Granted on Appeal ref: PL0.241624 on the 12/12/2013
13/681	Boolynagleragh Wind Farm	Seven turbine extension to Boolynagleragh Wind Farm and all associated works Permitted turbines have an overall maximum height of up to 126 metres. Located circa 12km to the east of the application site. Operational	Granted on Appeal ref: PL03.244095 13/06/2016
14/309	Glenmore Wind Farm	Extend the Appropriate Period of Planning Permissions P02/2228 and P09/438 for the construction of Windfarm consisting of 11 turbines, access roads, cabling and substation compound Located circa 6.2km to the east of the application site. Not constructed.	EOD granted by Clare County Council 21.07.2014, expired 26/06/2017
14/551	Cahermurphy Wind Farm	A ten year planning permission to construct a 4 turbine wind farm and all associated infrastructure in the townland of Cahermurphy, Kilmihil. The permitted turbines are up to 131m in height. Located to the immediate east of the application site. Phase 1 – 3 of 4 turbines constructed and operational	Granted on Appeal, ref: PL03.245189 28/07/2016
14/575	Glenmore Wind Farm	Twelve turbine wind farm with a maximum overall blade tip height of up to 136.5m, and all associated works Located approximately 7km to the south-east of the application site.	Granted on Appeal Ref: PL03.245392 24/10/2016

Planning Ref.	Site Name	Summary Description	Decision
		Under Construction	
15/474	Tullabrack Wind Farm	Extend the Appropriate Period of a Planning Permission P10-64 for a 6 turbine wind farm overall height 120.5m substation and all associated works. Located circa 12km south-west of the application site Operational	Clare County Council granted permission 28.08.2015; extension until 17/07/2020
18/830	Boolynagleragh Wind Farm	Relocation of 2 no. previously permitted wind turbines at Boolynagleragh Wind Farm (Clare County Council , Pl. Ref. 09-479, An Bord Pleanála PL.03.236376). Located circa 12km east of the application site. Under Construction	Clare County Council granted permission on the 21/01/2019
19/159	Mid Clare Renewable Energy DAC	Amendment to the previously permitted Wind Farm in the townland of Cahermurphy, Kilmihil, Co. Clare (Clare County Council Pl. Ref. P14-551, An Bord Pleanála PL03.245189) Amending the height of turbine no. 3 of the previously permitted Cahermurphy Wind Farm to a tip height of up to 150m (increase in tip height of 19m from the previously approved 131 m turbine) Permitted; not yet constructed	Clare County Council granted permission on 30/05/2019
19/388	Crossmore Wind Farm	Extend the Appropriate Period of Planning Permission P09/123 for proposed development which will consist of Seven wind turbines with a hub height of 80m and blade diameter of 90m, construction of substation, access roads and associated works. Located circa 10km southeast of the application site. Permitted; not yet constructed	EOD granted by Clare County Council 10/07/2019; EOD expires 24/11/2024

A range of other energy related planning applications exist within 2km of the proposed wind farm development site and in the vicinity of the cable route. These are outlined below in Table 7.30.

Table 7-30: Other Renewable Planning Applications

Planning Ref.	Summary Description	Decision
11/340	Permission to extend the lifetime of the existing electrical substation at Booltiagh from a planning lifetime of 20 years as granted under ABP Ref. 03 120616 to a permanent structure and the construction of a permanent extension to the existing electrical substation building as granted planning under ABP Ref. PL03120616.	Granted by Clare County Council on the 31/07/2011
13/558	Revised electricity substation in the townland of Knockalassa. This application represents an amendment to the substation already granted permission under Pl. Ref. No. P10/9 (An Bord Pleanála Ref: PL03.237524) The revised substation/ layout includes 3 No. control buildings, associated electrical plant and equipment and ancillary works.	Granted by Clare County Council on the 24/01/2014
14/545	To construct a new 38kV overhead line connecting the Boolynagleragh wind farm with the existing 110 kV substation at Booltiagh. The line will be approximately 7.1km long and is located in the townlands of Boolynagleragh, Letteragh, Lisroe, Boolyneaska and Booltiagh. The majority of the overhead line structures are wooden polesets; the two end masts are steel structures. All structures range in height from 10m to 18m	Granted by Clare County Council on the 31/05/2015
14/761	For development at Booltiagh 110 kv electrical transformer station consisting of alterations and extension to the existing Booltiagh 110 kv station to include; extension of existing 110 kv bus-bar, installation of 2 no. 110/38 kv bunded transformers and associated 110 kv and 38 kv transformer bays and 2 no. Arc Suppression Coils; construction of single storey control building; installation of 1 no. 38kv/MV bunded transformer; 4 no. lightning monopoles 18 metres high; replacement 110kV over-head line end mast 15 metres high and all associated works.	Granted by Clare County Council on the 09/12/2015
16/1011	Refurbishment of the existing Moneypoint - Oldstreet 400 kV overhead line.	Granted by CCC on the 24/09/2017
17/348	Temporary meteorological mast for the purpose of collecting meteorological data at Slaghbooly, Co. Clare.	Granted permission on the 03/07/2017. The decision was upheld by An Bord Pleanála on the 02/02/2018
17/703	Development of a quarry and all associated site development and infrastructure works and services.	Granted by Clare County Council on the 18/03/2018

Planning Ref.	Summary Description	Decision
18/223	Battery storage compound adjacent to an existing 110KV electricity substation and all associated/ancillary works.	Granted by Clare County Council on the 16/06/2018
19/299	Construction of a battery storage compound adjacent to the existing Glenmore electricity substation and all ancillary site works.	Granted by Clare County Council on the 09/09/2019

Finally, a range of non-renewable energy related planning applications (existing and permitted) exist within 2km of the proposed cable route options. The 2 km distance from the proposed works along the grid connection options reflects a generous area in terms of identifying permissions which may have the potential to be affected by any works. It would be considered to be in the sensitive receptor zone i.e. shadow flicker and noise.

Many of the noted applications relate to agricultural developments and/or signal residential developments. Table 7.31 below lists those planning applications identified within the vicinity of the development site.

Table 7-31: Non-Renewable Energy Related Planning Applications

Planning Ref.	Summary Description	Decision
94/215	Construct an extension to existing dwelling house.	Granted by Clare County Council on the 08/06/1994
95/486	Construction of a dormer bungalow, private garage and septic tank.	Granted by Clare County Council on the 15/09/1995
95/846	Permission to construct a low power transposer station	Granted by Clare County Council on the 18/01/1995
03/2499	Dwelling house, septic tank and foul sewer treatment plant	Granted by Clare County Council on the 13/08/2004
04/2605	Retain existing dwelling house and site works as constructed	Granted by Clare County Council on the 30/04/2005
04/2729	Retain existing house, entrance and site works	Granted by Clare County Council on the 26/03/2005
05/152	Relocate water storage reservoir and ancillary works on site as granted previously under Planning Ref. P03/984	Granted by Clare County Council on the 05/05/2005

Planning Ref.	Summary Description	Decision
05/2227	Reconstruct the existing dwelling house and all associated site works	Granted by Clare County Council on the 22/06/2006
05/88	To construct a 3 bay slatted shed	Granted by Clare County Council on 02/07/2005
061753	The construction of seven detached dwellinghouses and all ancillary works	Granted by Clare County Council on the 28/02/2007
06/376	Dwelling house, garage and treatment unit, including all ancillary works for the development	Granted by Clare County Council on the 27/07/2006
06/587	Demolition of an existing stone outbuilding and steel haybarn, the extension and refurbishment of an existing cottage and all associated works	Granted by Clare County Council on the 12/06/2006
06/678	Dwelling house, septic tank and foul sewer treatment plant	Granted by Clare County Council on the 14/09/2006
06/786	Retention permission for an existing constructed septic tank, percolation area and to demolish original septic tank and soakpit	Granted by Clare County Council 02/07/2006
06/1053	Dormer residence, entrance, driveway, septic tank and percolation area and all associated site development works	Granted by Clare County Council on the 06/08/2006
06/2719	Extension to a dormer residence and all associated site development work	Granted by Clare County Council on the 03/05/2007
06/2854	Domestic garage	Granted by Clare County Council on the 08/03/2007
0/6842	Retention permission for alterations to existing dwellinghouse as granted under P01/964	Granted by Clare County Council 10/07/2006
07/235	Extension to dwelling house	Granted by Clare County Council on the 30/04/2007
07/867	Slatted house and ancillary site works	Granted by Clare County Council on the 24/06/2007

Planning Ref.	Summary Description	Decision
07/1810	Single storey pitched roof dwelling house and a single storey detached garage, to install a proprietary waste water treatment system and percolation area, and associated site works	Granted by Clare County Council on the 12/01/2008
07/2066	Demolition of existing dwelling and outbuilding and for permission to construct a dwelling house as a replacement for existing dwelling house and all ancillary works.	Granted by Clare County Council on the 21/01/2008
07/2698	Dwelling house, a sewage treatment plant and a private garage c/w ancillary site works	Refused by Clare County Council
07/2712	Permission to erect dwelling house, septic tank and foul sewer treatment plant.	Granted by Clare County Council on the 01/09/2008
08/341	Extension to dwelling house.	Granted by Clare County Council on the 01/06/2008
08/849	Dormer type dwelling, private garage, wastewater treatment system and entrance.	Granted by Clare County Council on the 17/08/2008
08/1701	Dwelling house, entrance, site boundaries and waste water treatment system	Refused by Clare County Council and An Bord Pleanála
08/1829	Dwelling house, a sewage treatment plant and a private garage c/w ancillary site works	Granted by Clare County Council on the 11/04/2009
09/438	Extend the Period of Validity of Planning Permission P02/2228 by 5 years.(Permission will cease to have effect on 28/06/2009)	EOD granted by Clare County Council
09/808	Dwelling house, garage, sewage treatment system and associated site works.	Granted by Clare County Council on the 22/10/2009
09/1128	Single storey bungalow and car garage with all associated site and development works	Granted by Clare County Council on the 12/06/2010
09/1264	Renovations to and extension of existing house and all associated works.	Granted by Clare County Council on the 14/03/2010
10/8003	For the Upgrading of Kilmaley/Inagh Group Water Treatment Plant	Granted by Clare County Council on 12/08/2010

Planning Ref.	Summary Description	Decision
11/130	Retention of loft conversion and dormer windows as constructed together with ancillary site works	Granted by Clare County Council on 14/05/2011
11/712	To construct an extension to existing rear extension, demolish existing rear extension, alter front elevation of existing dwelling, upgrade existing sewage treatment system and associated site works	Granted by Clare County Council 26/03/2012
11/529	Dwelling house, sewage treatment plant, associated site works and connect to ancillary services	Refused by Clare County Council
11/809	Dwelling house, sewage treatment plant, and associated site works	Granted by Clare County Council on the 05/05/2012
12/727	To Extend the Appropriate Period of Planning Permission P07/2066 for a single storey dwelling house	EOD granted by Clare County Council
13/384	Retention of the fully serviced prefabricated classroom.	Granted by Clare County Council on the 11/10/2013
14/397	To de-commission the existing septic tank servicing the National School and to provide a new wastewater treatment system on site with all associated site works	Granted by Clare County Council on the 16/10/2014
14/615	Upgrading (widening and strengthening) of the existing forestry tracks and all associated works which will provide an alternative means of access to facilitate the construction of the initial phase of the wind farm permitted Pl. Ref P10-9.	Granted by Clare County Council on the 12/01/2015
14/614	Electricity substation already granted permission under Pl. Ref. No P02-2228 (as extended by Pl.Ref's P09-438 or P14-309)..	Granted by Clare County Council on the 12/06/2015
15/480	To construct a new dwelling house with all necessary ancillary services	Granted by Clare County Council on 03/12/2015
16/510	Retention permission for an existing 18 metre lattice telecommunications support structure (previously granted permission under reference P09-963), carrying antennae and link dish, together with associated equipment units and fencing	Granted by Clare County Council on the 08/09/2016
16/257	Slatted unit with an underground slurry storage tank for housing livestock	Granted by Clare County Council on the 21/06/2016

Planning Ref.	Summary Description	Decision
16/1011	Works associated with the refurbishment of the existing Moneypoint - Oldstreet 400 kV overhead line and all associated works.	Granted by Clare County Council on the 24/09/2017
17/651	For development which will consist of an extension to the existing school, consisting of a classroom, toilets and a store room, cloak room and all ancillary site works	Granted by Clare County Council on the 18/11/2017
17/703	Quarry and all associated site development and infrastructure works and services.	Granted by Clare County Council on the 18/03/2018
17/907	Construction of a temporary bell-mouth entrance to facilitate the occasional vehicular access from a future forestry road to a public road (western side) and associated works	Granted by Clare County Council on the 25/02/2018
17/908	Construction of a temporary bell-mouth entrance to facilitate occasional vehicular access from a future forestry road to a public road (eastern side) and associated works	Granted by Clare County Council on the 25/02/2018
18/555	For development which will consist of the installation of battery arrays located within container units a control building and transformer and all associated works.	Granted by Clare County Council on the 30/09/2018
18/930	Construction of ballroom/function room, leisure facility including restaurant; 53 dwellings for tourist accommodation; gatehouse; car parking. Dismantling and removal of existing marquee structure.	Granted by Clare County Council on the 09/10/2019
18/1038	Permanent health and safety sign including all ancillary site works	Granted by Clare County Council on the 18/03/2019
191005	Retention of a private artist studio which replaced a derelict shed on the same site.	Refused by Clare County Council on 21/02/2020. Appealed to ABP(ref: 306930) - live
19/868	Permanent health and safety sign including all ancillary site works at the entrance to Glenmore Wind Farm	Granted by Clare County Council on the 24/01/2020
19/869	Permanent health and safety sign including all ancillary site works, at the entrance to Glenmore Wind Farm	Granted by Clare County Council on the 24/01/2020

Planning Ref.	Summary Description	Decision
20264	To develop a new off road car parking facility and set down area with all necessary ancillary works	pending

7.7.1 Tree Felling and Replanting

The site of the proposed wind farm and along the route of the grid connection was originally planted as a commercial crop and will be felled in the future should the proposed wind farm proceed or not.

A small proportion of the commercial crop (34.11ha) will be felled to accommodate the wind farm development. This includes a total of 27.6 hectares within and around the footprint of the Proposed Development and 6.51 hectares along the grid connection route. A total area of approximately 34.11 hectares of commercial forestry will require replanting elsewhere in the State and this forms part of the project for assessment. Details regarding the area to be felled are described in Chapter 4 of the EIAR as provided in Appendix 2.

The Forest Service policy on the granting of felling licences requires replanting of forestry on a hectare-by-hectare basis. Four potential replanting areas have been identified for assessment purposes, with an availability of 36.72 hectares, located in Brackloon, Co. Roscommon, Cooraclare, Co. Clare, Pollnabrone, Co. Galway and Stranamart, Co. Cavan. These lands have been granted Forest Service Technical Approval for afforestation, and this or similarly approved land will be used for replanting should the proposed development receive planning permission. These replanting lands have been assessed as shown in Appendix 4.3 of the EIAR and have been considered as part of this cumulative assessment.

In the review of the other projects that was undertaken, no connection between the sites, 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 wind farm development.

Taking into consideration the reported residual effects from other plans and projects in the area and the predicted effects with the current proposal, no potential for significant cumulative effects on biodiversity exists.

7.7.2 Conclusion of Cumulative Assessment

Following the detailed assessment provided in the preceding sections, it is concluded that, the proposed development will not result in any residual adverse effects on biodiversity. There is therefore no potential for the proposed development to contribute to any cumulative adverse effects on biodiversity 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.

Taking into consideration the reported residual impacts from other plans and projects in the area and the predicted impacts with the current proposal, no residual cumulative impacts have been identified with regard to Biodiversity.

7.8 CONCLUSION

Following consideration of the residual effects (post-mitigation) it is noted that the proposed development on its own, or in combination with any other development, will not result in any significant effects on any of the identified KERs. No significant effects on receptors of International, National or County Importance were identified.

A hen harrier habitat enhancement plan has been prepared for the proposed development which will result in an overall increase in peatland habitat as a result of the proposed development. This plan identifies an area of 28.2 ha of forestry on which to restore peatland habitats.

The proposed wind farm development will be constructed and operated in strict accordance with the design, best practice and mitigation that is described within this application and as such, significant effects on ecology are not anticipated at any geographical scale on any of the identified KERs.

8. ORNITHOLOGY

8.1 Introduction

This chapter assesses the likely significant effects that the Proposed Cahermurphy Two Wind Farm (the 'Proposed Development') 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 1976 -2012 as amended 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 8-1 to 8-4, which contains data from the surveys undertaken including full details of the survey times, weather conditions, and other relevant information together with the bird records themselves.

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 survey 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 SNH Guidance (2017), includes direct habitat loss, displacement and death from collision. 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 ameliorate 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 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).
- "Wind Farm Site" is defined as all infrastructure associated with the development with the exception of the grid connection route.
- "Grid Connection Route" is defined as the cable route from the Wind Farm Site to the existing Booltiagh 110kV substation. Connection via the Booltiagh route would comprise underground cabling, measuring approximately 12.1 km in total, located on existing forestry and agricultural land and within the public road corridor.
- The "proposed development" refers to both the Wind Farm Site and Grid Connection Route.

8.1.1 Development Description

The proposed development is described in detail in Chapter 4 Section 4.1 and will include up to 10 No. turbines with a tip height of up to 170 metres and all associated foundations and hardstanding areas, access roads including upgrade of existing site roads and provision of new roads, 1no. 38kV electrical substation which will be constructed at one of two possible locations on site: either Option A in Carrownagry South townland or Option B in Cahermurphy townland, grid connection via underground cable, site drainage and all associated works. The Proposed Development will have an operational life of 30 years from the date of commissioning of the wind farm.

8.1.2 Legislation, Guidance and Policy Context

This EIAR is prepared in accordance with the requirements of the 2011 EIA Directive as amended by EIA Directive 2014/52/EU.

The following are the key legislative provisions applicable to habitats and fauna in Ireland:

- Irish Wildlife Acts 1976 to 2012 as amended.
- The European Communities (Birds and Natural Habitats) Regulations 2011 (transposes EU Birds Directive 2009/147/EC , and the EU Habitats Directive 92/43/EC).
- The International Convention on Wetlands of International Importance especially as Waterfowl Habitat 1971.

In the absence of specific National Irish Ornithological Survey Guidance, the 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. http://www.snh.gov.uk/docs/B721137.pdf.
- 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.

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.
- Clare County Development Plan 2017-2023.
- EPA (2017) Guidelines on the Information to be contained in Environmental Impact Assessment Reports – Draft August 2017'.
- EPA (2015) '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 (2003)'Advice Notes on Current Practice in the Preparation of Environmental Impact Statements'
- EPA (2002) '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.
- 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.*
- European Commission (2017). Environmental Impacts Assessment of Projects. Guidance on the preparation of the Environmental Impact Assessment Report.
- CIEEM (2017) Guideline for Ecological Report Writing

8.1.3 Statement of Authority and Competence

This ornithology chapter has been prepared by Senior Ornithologist, Mr. Padraig Cregg (BSc., MSc.) with the assistance of Ecologist, Mr Ian Hynes (BSc.), of McCarthy Keville O'Sullivan Ltd. (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 Senior Ornithologist, Mr. Alex Ash (BSc.) and is fully compliant with recent SNH guidance. The chapter has been reviewed by Pat Roberts (B.Sc. Environmental Science) who has over 14 years' experience in management and ecological assessment.

Field surveys on the Wind Farm Site were undertaken by John Hehir (B.Sc.), Joe Kelly (B.Sc.), Ciaran McKenna (B.Sc.), Patrick Manley (B.Sc.), Tony Kenneally (B.Sc), and Athena Michaelides (BSc.), Chris Peppiatt (PhD), Declan Manley (BTO C License, BTO Trainer Licence and Irish Ringing Licence from the NPWS), John Meade (B.Sc.) and Paul Troake (NDIP). All of the above surveyors are competent experts for the purposes of the preparation of this EIAR and suitably qualified.

8.2 Assessment Approach and Methodology

8.2.1 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.

8.2.2 Consultation

8.2.2.1 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 2.5 of Chapter 2.

Table 8-1 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 2.4 in Chapter 2 of this EIAR describes where the comments raised in the scoping responses received have been addressed in this assessment.

Table 8-1 Consultation Responses

	Consultee	Response
01	An Taisce	No response to date
02	BirdWatch Ireland	Response received on 05th June 2019, stating that project information had been forward to relevant persons in the organisation.
03	Department of Agriculture, Food and the Marine	No response to date
04	Department of Culture, Heritage, and the Gaeltacht	Response received on 19th July 2019. Noting the presence of breeding hen harrier and curlew habitat locally.
05	Clare County Council Heritage Officer	Response received on 19th July 2019
06	Irish Red Grouse Association	No response to date
07	Irish Raptor Study Group	No consultation response received to date. Acknowledged receiving a consultation request on the 18th of June 2019
08	Irish Wildlife Trust	No response to date

8.2.3 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 Wind Farm Site 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 8-1) 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 effects.
- Species protected under the fourth schedule of the Wildlife Acts 1976-2012 as amended.
- 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.

8.2.4 Field Surveys

Field surveys were undertaken during the survey period April 2017 to September 2019. 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. The study area/ area surveyed for each type of survey is discussed in the methodology section below. The survey radii mentioned below are discussed in relation to the Wind Farm Site, unless stated otherwise.

8.2.4.1 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.

8.2.4.2 Survey Methodologies

The survey work undertaken between April 2017 and September 2019 forms the core dataset for the assessment of effects on ornithology.

In the absence of specific national bird survey guidelines, the ornithological surveys were designed and undertaken in full accordance with *Survey methods for use in assessing the impacts of onshore windfarms on bird communities'* (SNH, 2017).

The various survey types undertaken are described below.

8.2.4.2.1 *Vantage Point Surveys*

Vantage Point Surveys were undertaken in accordance with SNH guidance from April 2017 to September 2019. Surveys were conducted monthly throughout this survey period from three fixed point vantage points (VP1, VP2, VP3) to allow comprehensive coverage of all proposed turbines and

surrounding study area. An additional VP was added in April 2018, which provides extra coverage of the western most margins of the Wind Farm Site. Figure 8.1 shows the VP locations.

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. Due to weather constraints, some surveys ended early. Surveys were orientated to provide a spread over the full daylight period including dawn and dusk watches to coincide with the highest periods of bird activity. Target species were as per listed in Table 1-1 of Appendix 8-1.

Survey effort for vantage point watches is presented in Appendix 8-2, Table 1-1. This includes full details of dates, times, survey locations, survey duration and weather conditions for each survey. Table 8-2 below shows a summary of the VP survey work undertaken at the core site boundary between April 2017 and September 2019.

Table 8-2 Vantage Point Survey Effort

Survey Season	Months	Minimum Effort per VP
2017 Breeding Season (3 VPs)	Apr – Sep	36 hours/VP
2017/2018 Non- Breeding Season (3 VPs)	Oct – Mar	36 hours/VP
2018 Breeding Season (4 VPs)	Apr – Sep	36 hours/VP
2018/2019 Non- Breeding Season (4 VPs)	Oct – Mar	36 hours/VP
2019 Breeding Season (4 VPs)	Apr – Sep	36 Hours/VP

Observed flight activity was recorded as per defined flight bands which were chosen in relation to the dimensions of proposed turbine models for the site. Bands were split into 0-10, 10-25m, 25m-175m and 175m+. The values of band 3 (25-175m) is considered potential collision height (PCH).

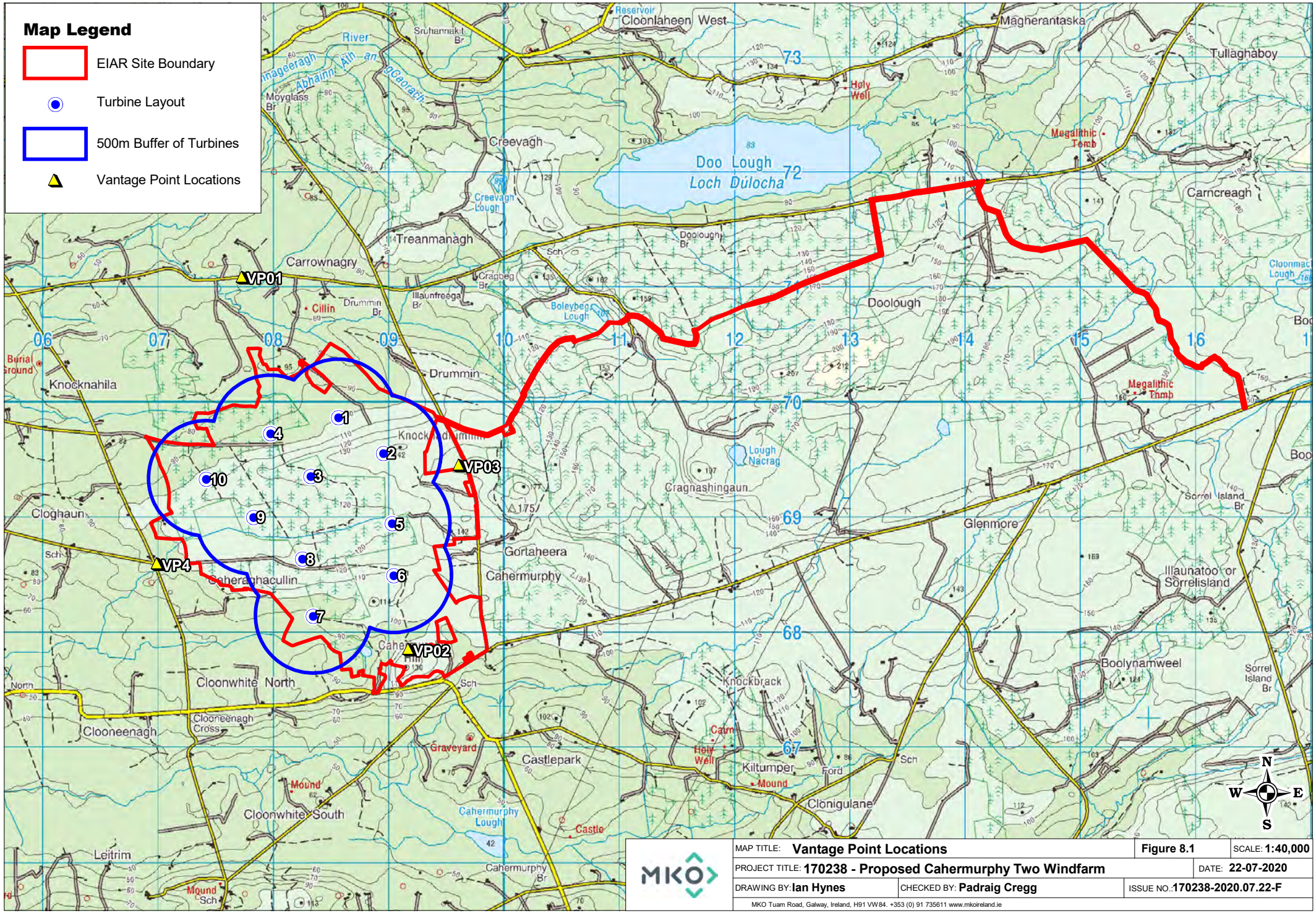
Each flight observation was assigned a unique identifier when mapped in the field and subsequently digitised using GIS software.

Viewshed Analysis

Viewshed analysis was carried out to inform coverage of the study area from fixed vantage point locations (i.e. VPs 01, 02, 03 and 4). 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 emphasizes 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 establish the physical visibility of the viewshed including landscape features (e.g. woodland, spoil heaps etc.) that are not accounted for in the computer modelling programme.

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). A 500m buffer was applied to the



MAP TITLE: **Vantage Point Locations**		**Figure 8.1**	SCALE: **1:40,000**
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outer most turbines of the Wind Farm Site in line with SNH (2014). At the time of selection for VPs the turbine model or swept heights were not known. As such all flights were recorded in height bands 0-10m, 10-25m, 25-175m and >175m. For the purpose of the collision risk model the height at which birds are at risk of collision is 25-175m. 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 sheds at 25m are presented on Figures 8.2, 8.2.1, 8.2.2, 8.2.3 and 8.2.4.

8.2.4.2.2 *Breeding Bird Surveys (Adapted Brown & Shepherd Survey)*

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 adapted Brown and Shepherd method as outlined in Gilbert et al. (1998) and SNH (2017). The survey area extended 500m beyond the site boundary as recommended by SNH (2017). Certain areas within 500m of the site proved inaccessible due to land owner constraints or the presence of areas of dense forestry and vegetation. Non-Coillte land holdings, could only be surveyed from areas where public access is permitted i.e. roads, or from areas within Coillte property.

Transect routes were devised to ensure coverage of different habitat complexes within the study area. The survey aimed to visit every areas of suitable breeding/ foraging habitat to within 100m, where access allowed. Target species were waders, raptors, waterbirds, gulls and other birds of conservation concern. Along with target species, all additional species observed were recorded to inform the evaluation of supporting habitat.

Walkover surveys were carried out during daylight hours during the core breeding season months of April, May, June and July (2017, 2018 and 2019). The area surveyed increased during the 2019 breeding season to ensure comprehensive coverage of the western margins of the study area. 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 8-2, Table 1-2. This includes full details of dates, times, survey locations, survey duration and weather conditions for each survey. Figure 8.3 in shows the transect routes surveyed.

8.2.4.2.3 *Breeding Raptor Surveys*

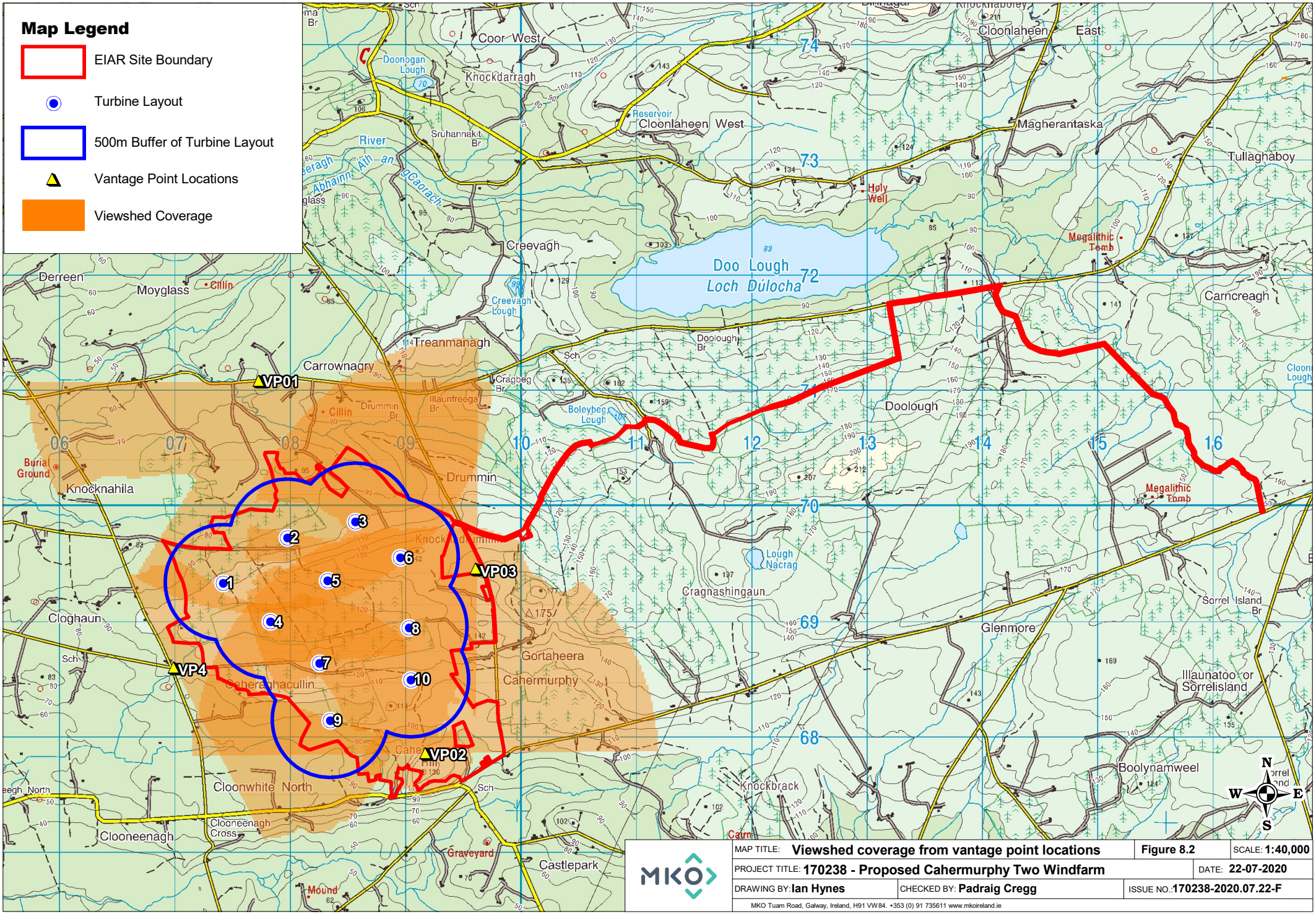
Breeding Raptor Surveys (i.e. birds of prey and owls) were undertaken within the study area and its immediate surrounds. Survey methodology was as outlined in Hardey et al. (2013), as per SNH (2017) recommendations. Following guidance from NPWS, informed by research carried out by University College Cork (Wilson et al. 2015), the Breeding Raptor Survey area exceeded the 2km recommended by SNH (2017), in order to account for the wide-ranging nature of hen harrier. All areas of suitable habitat within 5km of the site boundary was surveyed for the presence of hen harrier, merlin, peregrine, red kite, goshawk and other more abundant raptor species.

Raptor surveys, in the form of walked transects (onsite) and VP watches, were conducted on a monthly basis during the core breeding season (April – July 2017, 2018 & 2019). The area surveyed increased during the 2019 breeding season to ensure comprehensive coverage of the western margins of the study area. The aim of these surveys was to identify breeding attempts and monitor their success, by any and all raptor pairs within the study area.

Survey effort details are provided in Appendix 8-2, Table 1-3. Figure 8.4 shows the areas surveyed.

8.2.4.2.4 *Breeding Woodcock Surveys*

Breeding Woodcock Surveys followed methods outlined by Gilbert et.al (1998). Dusk surveys were undertaken in areas of suitable breeding habitat (i.e. forestry/woodland) during May and June 2017,



MAP TITLE: **Viewshed coverage from vantage point locations**		**Figure 8.2**	SCALE: **1:40,000**
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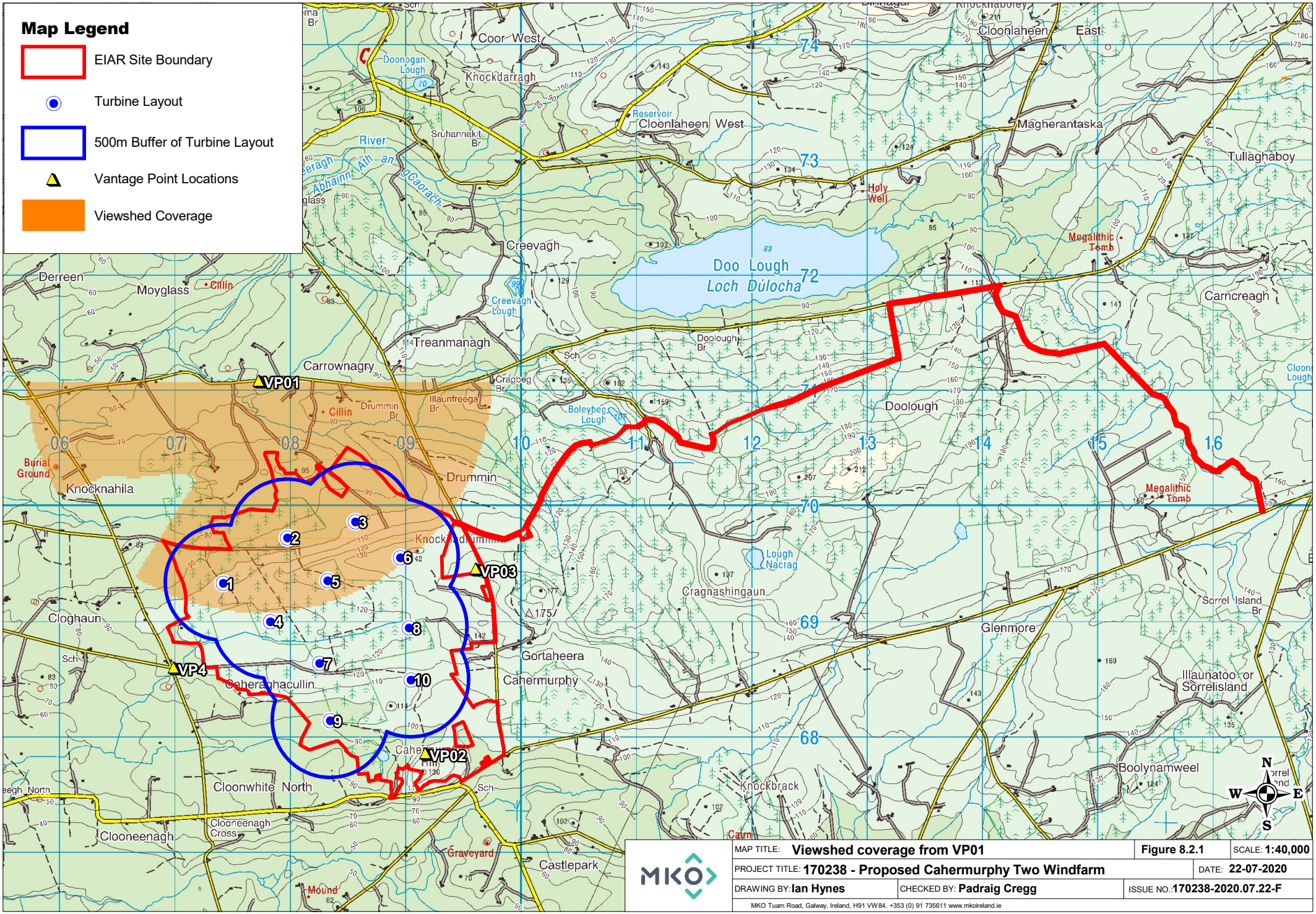

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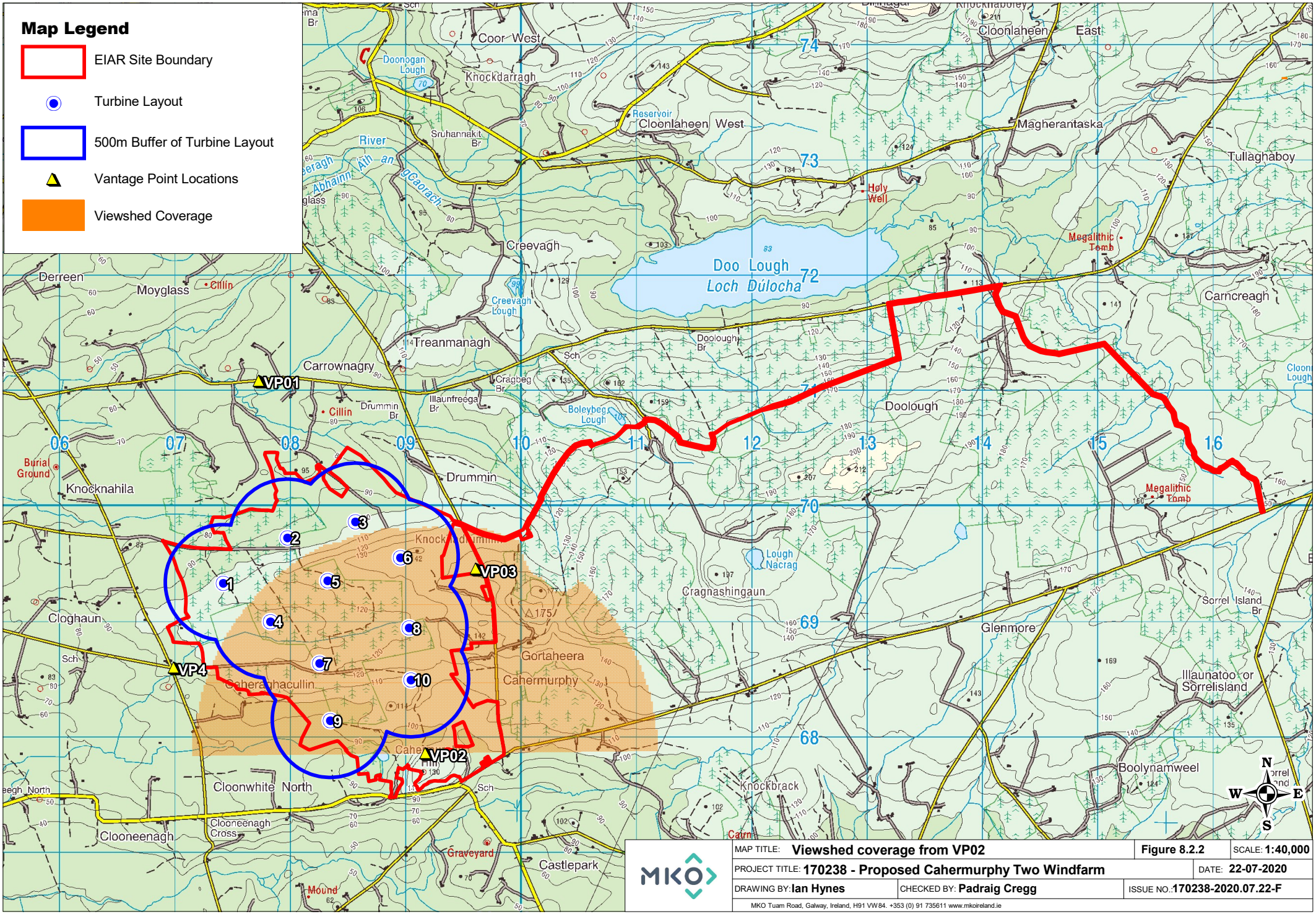

MAP TITLE: **Viewshed coverage from VP02**		**Figure 8.2.2**	SCALE: **1:40,000**
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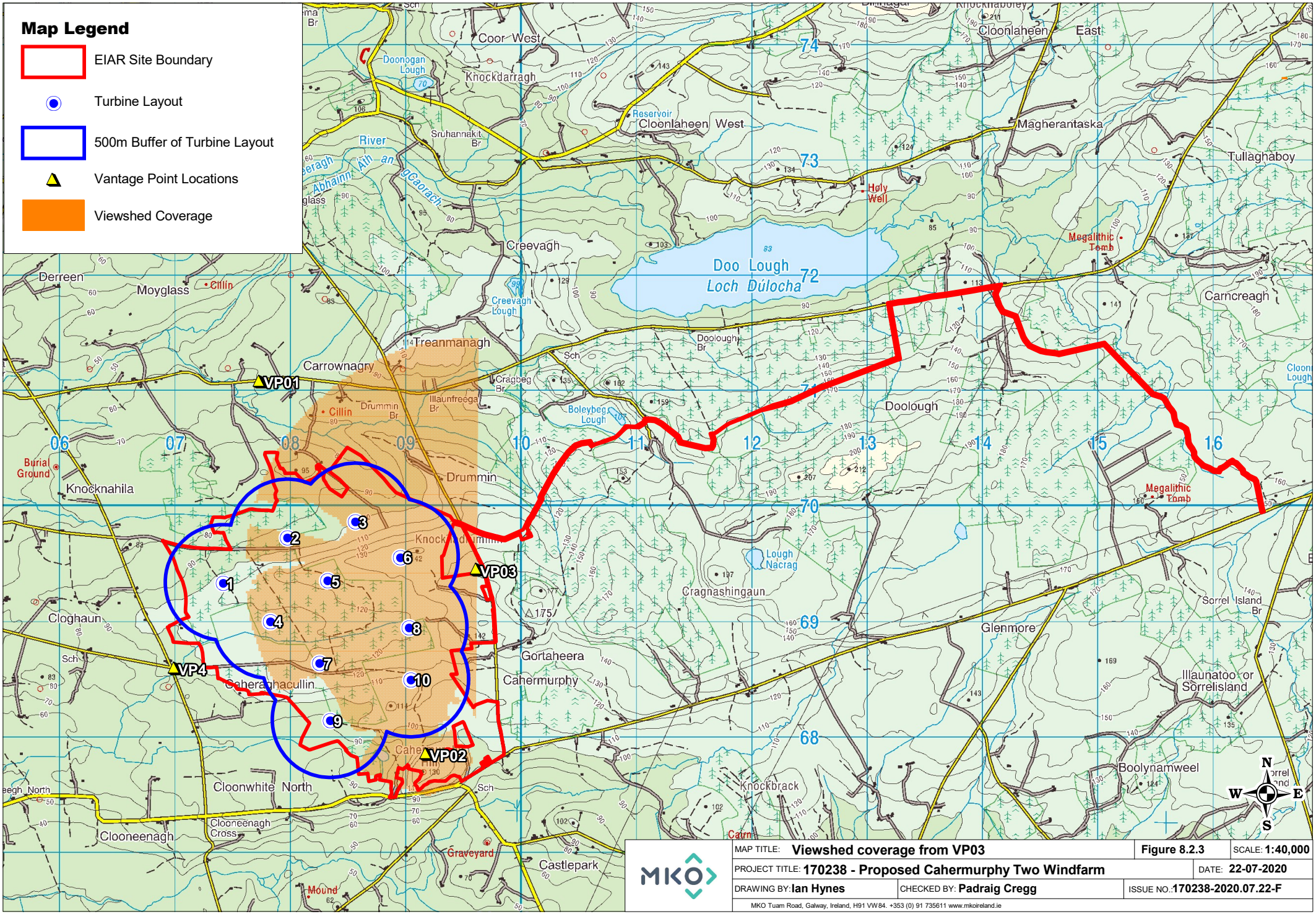

MAP TITLE: **Viewshed coverage from VP03**		**Figure 8.2.3**	SCALE: **1:40,000**
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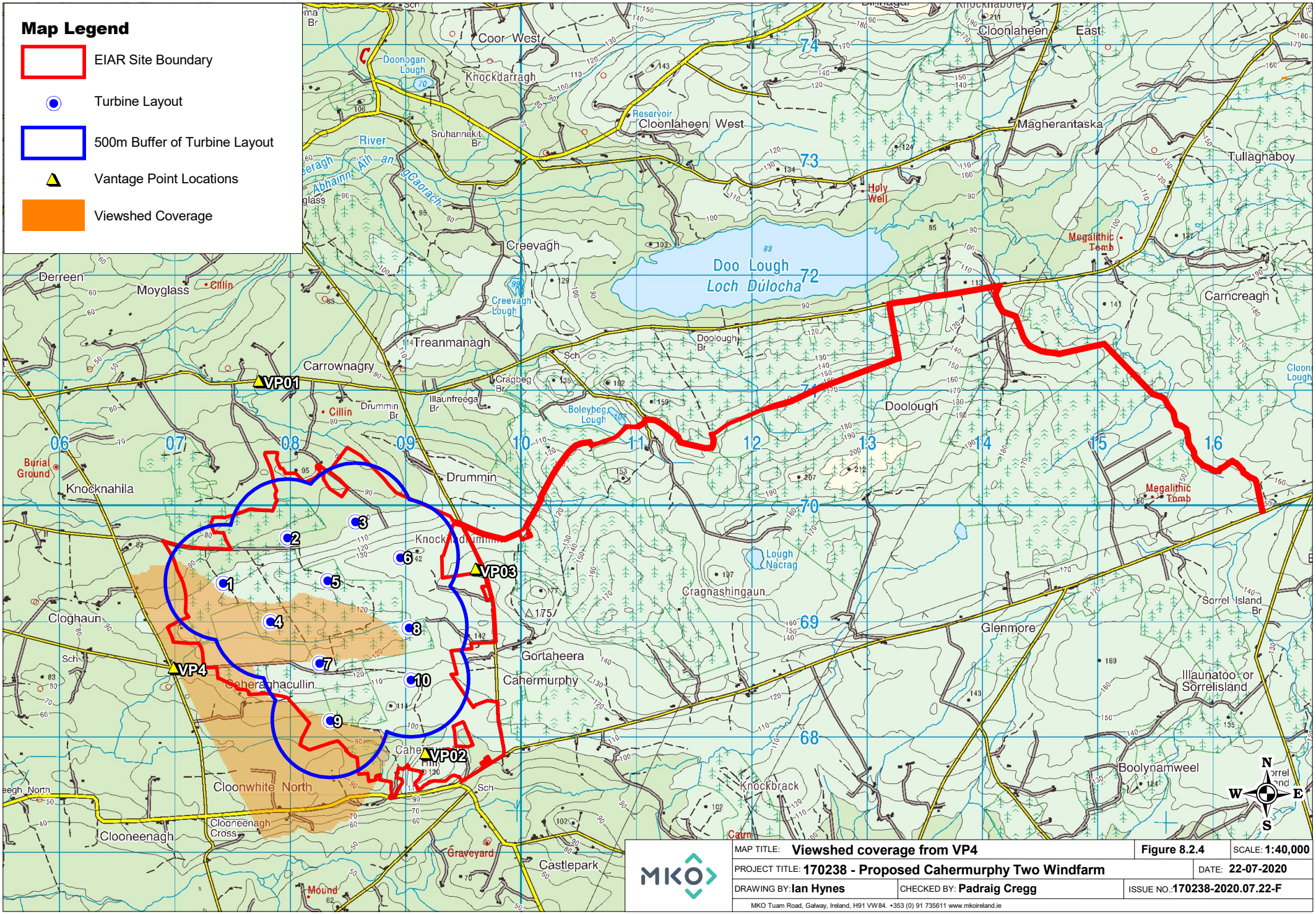

MAP TITLE: **Viewshed coverage from VP4**		**Figure 8.2.4**	SCALE: **1:40,000**
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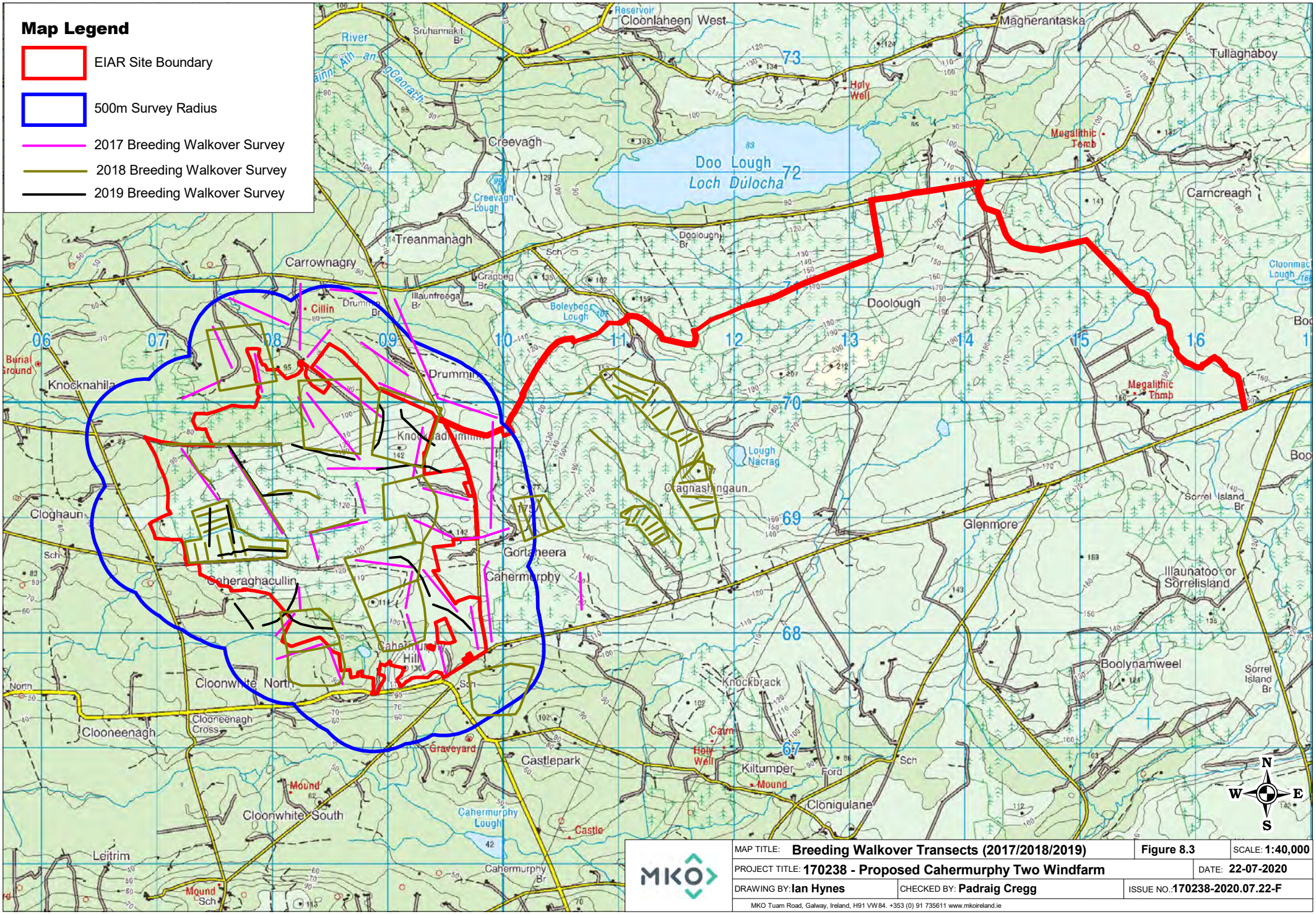

MAP TITLE: **Breeding Walkover Transects (2017/2018/2019)**		**Figure 8.3**	SCALE: **1:40,000**
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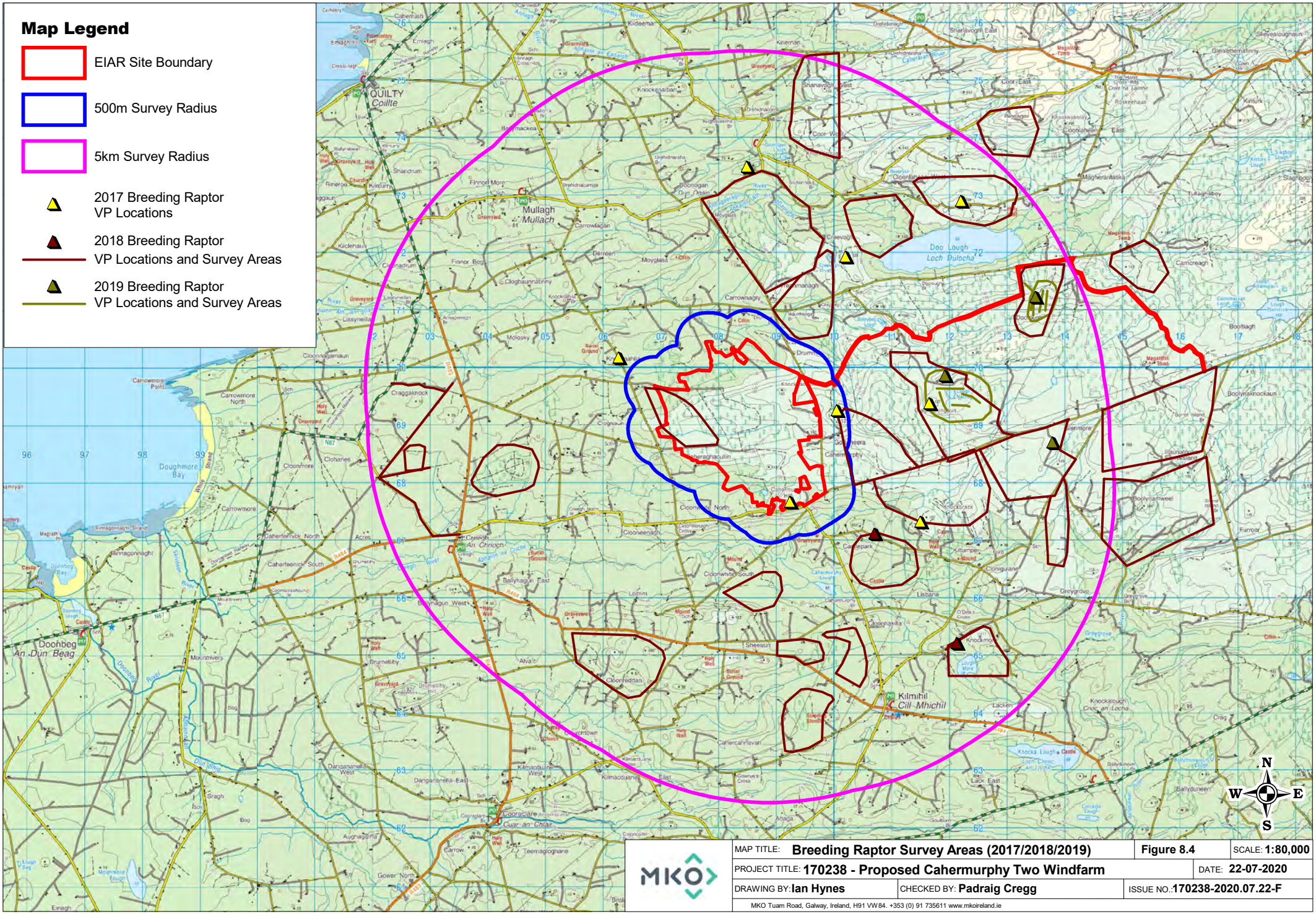

MAP TITLE: **Breeding Raptor Survey Areas (2017/2018/2019)**		**Figure 8.4**	SCALE: **1:80,000**
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June 2018 and May and June 2019. The survey area extended 500m beyond the site boundary (where access allowed). Surveys commenced one hour before sunset 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. All observations of woodcock (as well as the areas covered) were recorded on 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 surveyor to survey for owls, i.e. barn owls and long-eared owls.

Survey effort is presented in Appendix 8-2, Table 1-4. This includes full details of dates, times, survey locations, survey duration and weather conditions for each survey. Figure 8.5 in shows the transect routes surveyed.

8.2.4.2.5 *Red Grouse Surveys*

Red Grouse Surveys were undertaken in March 2019. Methodology was derived from that described in Bibby et al. (2000) and the survey methods for the most recent national Red Grouse survey (2006/2007 to 2007/2008) coordinated by BirdWatch Ireland and submitted to the NPWS (Murray et al., 2013). The survey area extended 500m beyond the site boundary in areas of suitable habitat (i.e. open moorland and areas of heather). Areas of forestry were not surveyed as they do not have potential to support red grouse populations. The surveyor used a tape lure method (under license from NPWS) to survey for resident birds. Survey details are provided in Appendix 8-2, Table 1-5. Figure 8.6 shows the areas surveyed.

The work was carried out under NPWS Licence Number 12/2019.

8.2.4.2.6 *Hen Harrier Roost Surveys*

Potential Hen Harrier roost sites within 2km of the Wind Farm Site (as per SNH 2017) were surveyed for the presence of Hen Harrier during the winter season. Survey work was undertaken in accordance with the methodology devised by Hardey et al. (2013) and the 'Irish Hen Harrier Winter Roost Survey' (unpublished document coordinated by members of NPWS). Surveys were carried out throughout the entirety of both non-breeding seasons (October 2017 - March 2018 & Oct 2018 – Mar 2019). Full details of survey effort are provided in Appendix 8-2 Table 1-6. Figure 8.7 shows the locations of Hen Harrier Roost Survey VP locations.

8.2.4.2.7 *Winter Walkover Surveys*

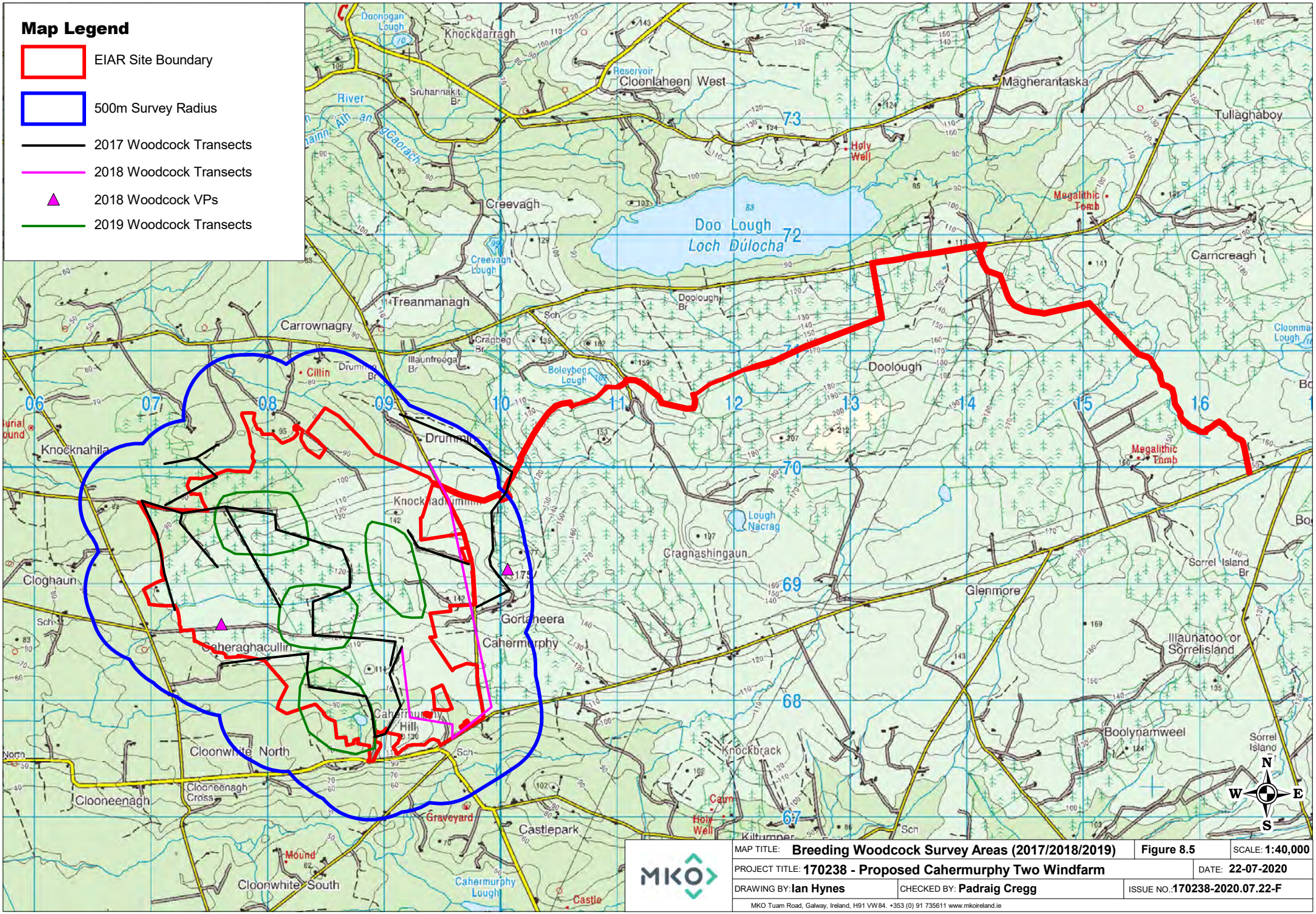
Winter Walkover Surveys were undertaken to determine the presence of bird species of high conservation concern within areas of potential suitable habitat in the study area. The survey area extended to a 500m radius of the site boundary (where access allowed).

Transect routes were devised to ensure coverage of different habitat complexes between vantage point locations within the study area, during winter months. Methodology was broadly based on methods described in Bibby et al. (2000) and Brown and Shepherd (1993). Target species were raptors, waterbirds, gulls and ground birds of conservation interest. Along with target species, all additional species observed were recorded to inform the evaluation of supporting habitat.

Survey effort, including details of survey duration and weather condition, is presented in Appendix 8-2, Table 1-7. Figure 8.8 shows the surveyed area.

8.2.4.3 Non-core Data Surveys

In addition to the field surveys discussed in Section 8.2.4.2 above (core data surveys), surveys were also undertaken to the east of the Wind Farm Site. A number of surveys were undertaken as part of a larger Wind Farm Site, which encompassed the current study area and a discrete parcel of land to the south



MAP TITLE: **Breeding Woodcock Survey Areas (2017/2018/2019)**		**Figure 8.5**	SCALE: **1:40,000**
PROJECT TITLE: **170238 - Proposed Cahermurphy Two Windfarm**			DATE: **22-07-2020**
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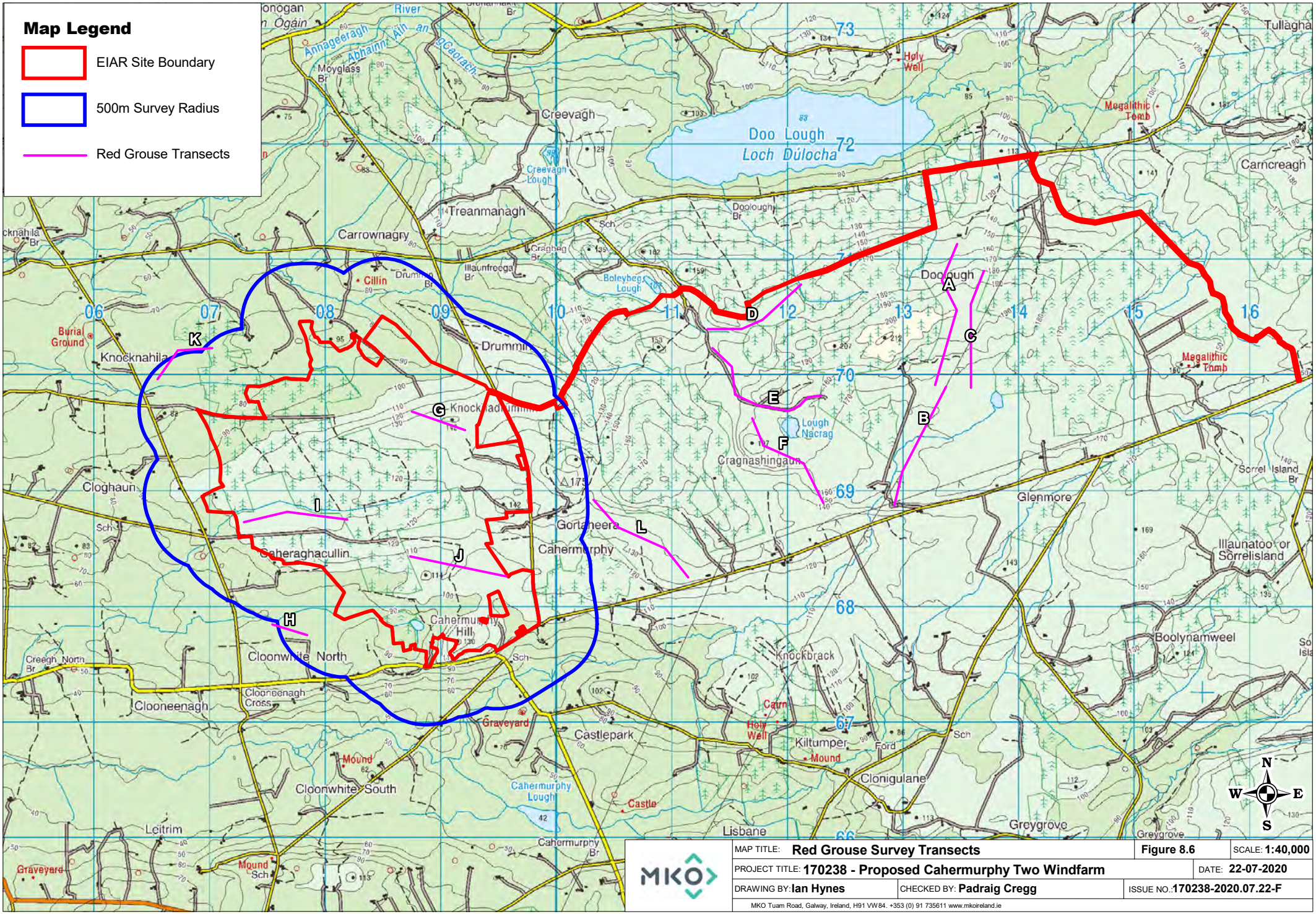

MAP TITLE: **Red Grouse Survey Transects**		**Figure 8.6**	SCALE: **1:40,000**
PROJECT TITLE: **170238 - Proposed Cahermurphy Two Windfarm**			DATE: **22-07-2020**
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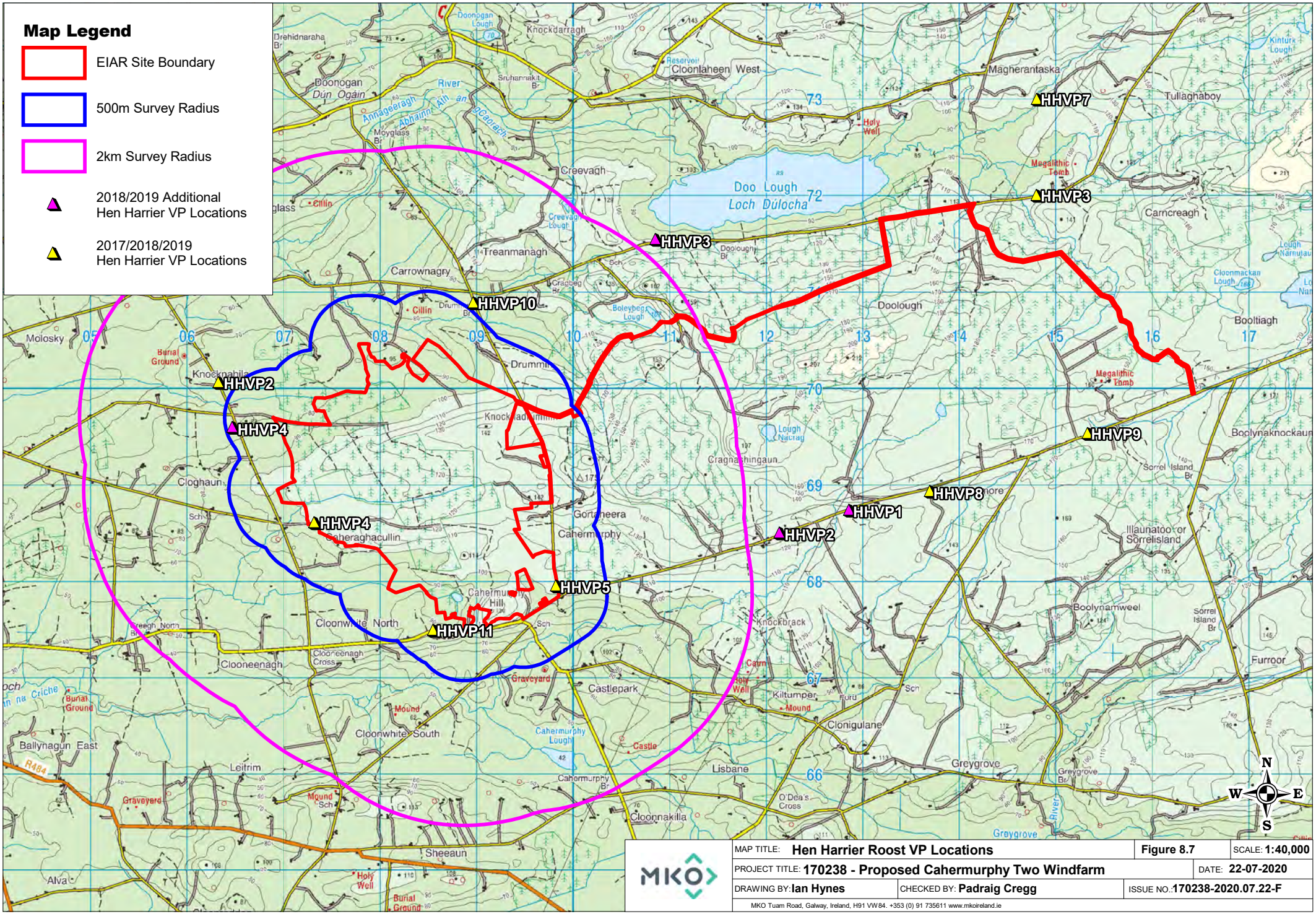

MAP TITLE: **Hen Harrier Roost VP Locations**		**Figure 8.7**	SCALE: **1:40,000**
PROJECT TITLE: **170238 - Proposed Cahermurphy Two Windfarm**			DATE: **22-07-2020**
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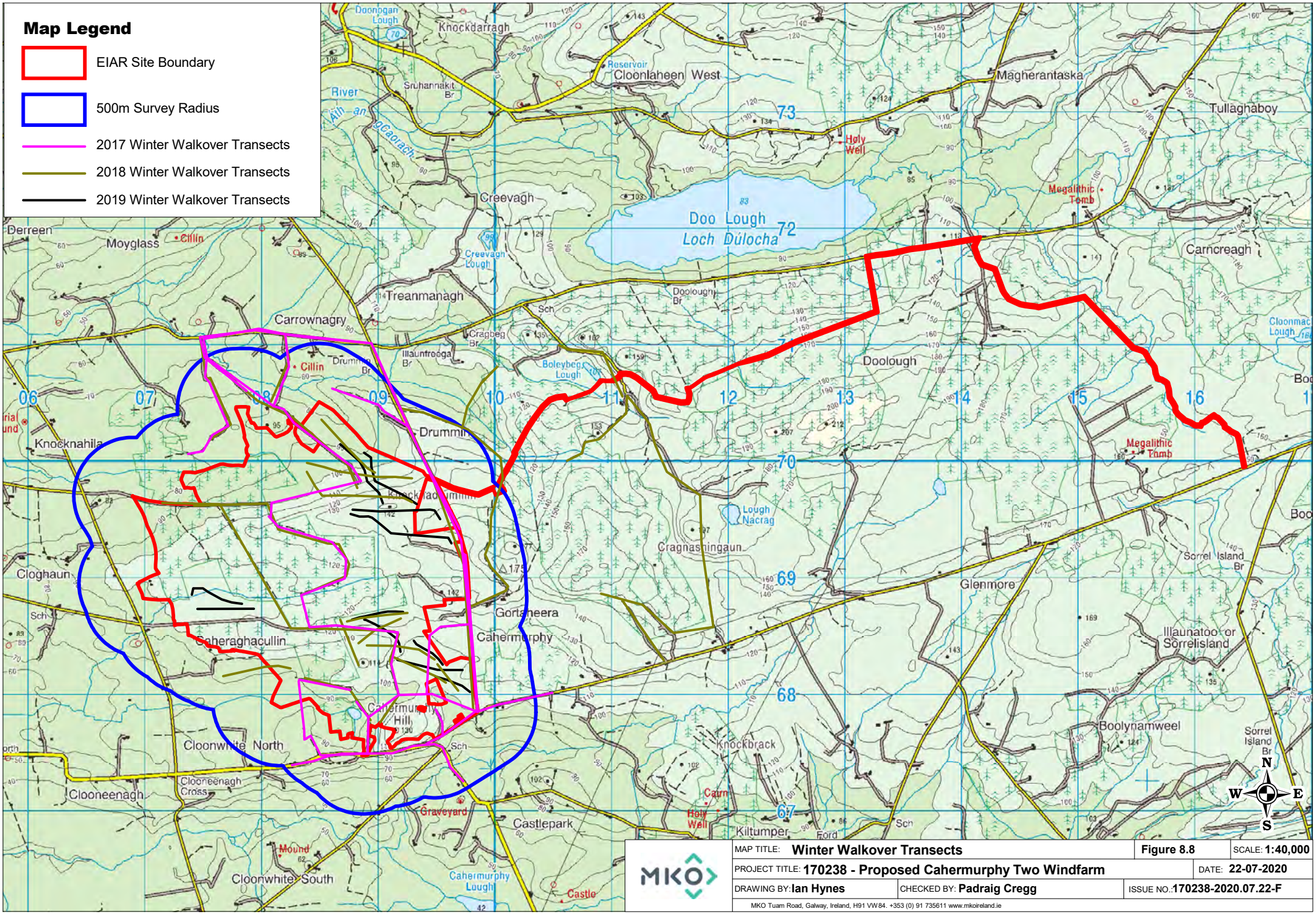
Map Legend
EIAR Site Boundary
500m Survey Radius
2017 Winter Walkover Transects
2018 Winter Walkover Transects
2019 Winter Walkover Transects
Doo Lough
Loch Dúlocha
Creevagh
Cloonlaheen West
Magherantaska
Tullaghaboy
Carncreagh
Doolough
Treanmanagh
Carrownagry
Moyglass
Derreen
Knocknahila
Drummin
Cloghaun
Caheraghacullin
Gortaneera
Cahermurphy
Cragnasningaun
Glenmore
Illaunatoo or Sorrelisland
Sorrel Island Br
Boolynamweel
Knockbrack
Kiltumper
Castlepark
Cloonwhite North
Cloonwhite South
Clooneenagh
Megalithic Tomb
Megalithic Tomb
Holy Well
Graveyard
Mound
Castle
Ford
Cairn
Lough Nacrag
Creevagh Lough
Boleybeg Lough
Cahermurphy Lough
Doonpgan Lough
Knockdarragh
Reservoir
River Ath an gCaorach
Sruhannakit Br
Cragbeg Br
Illauntreega Br
Doolough Br
Drummin Br
Cillin
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Sch

of Doo Lough. The development boundary went through various iterations before settling on the current development boundary which is the subject of this planning application. These iterations included the omission of the parcel of land to the south of Doo Lough from the Wind Farm Site.

Surveying was undertaken between April 2017 and March 2019, during this period surveys were undertaken in accordance with SNH (2017) recommendations. The following surveys were conducted: vantage point surveys, breeding walkover surveys, breeding raptor surveys, red grouse surveys, breeding woodcock surveys, winter walkover surveys and hen harrier winter roost surveys. The survey methods were as described in Section 8.2.4.2.

8.2.5 Ornithological Evaluation Criteria and Impact Assessment Methodology

8.2.5.1 Potential Effects Associated with the 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 has been utilised to predict the potential effects of the Proposed Development on birds. Effects are assessed with regard to the construction phase, the operational phase, decommissioning and cumulatively in consideration with other projects and plans.

8.2.5.2 Geographical Framework

Guidance on Ecological Impact Assessment (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.

8.2.5.3 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 8-3 - Sensitivity, Table 8-4 – Magnitude of effect,

Table 8-5 – Determination of significance) outline the assessment criteria for each stage.

Table 8-3 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.
High	Species that contribute to the integrity of an SPA but which are not cited as 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 8-4 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

Sensitivity	Description
Negligible	Very slight change from baseline condition. Change barely distinguishable, approximating to the "no change" situation. Guide: < 1% population/ habitat lost

Table 8-5 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

8.2.5.4 Impact Assessment – EPA Criteria (2017 Draft)

Effects identified as per the Percival 2003 criteria have been equated with EPA impact assessment criteria described below.

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)

- Criteria for assessing impact significance and impact quality are provided in Table 8-6 and Table 8-7.

Table 8-6 Criteria for assessing impact significance based on (EPA, 2017)

Impact Magnitude	Definition
Imperceptible Effect	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.

Impact Magnitude	Definition
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
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

Table 8-7 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)

EPA impact assessment criteria have been used in this assessment for consistency between the biodiversity and ornithology chapters. Percival (2003) has also been followed in the assessment of potential impacts given its specific focus on the interactions between wind farms and birds. The two assessment criteria have been used to independently characterise impacts to inform a robust assessment of potential impacts resulting from the proposed development site on local avian communities.

8.2.5.5 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 8-6 for full details on the collision risk modelling method.

8.2.6 Survey Justification

A comprehensive suite of bird surveys has been undertaken at the Proposed Development site between April 2017 and September 2019.

Results are derived from a continuous two years of surveying undertaken in strict accordance with SNH Guidance. These are the results that are analysed to inform this assessment.

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. The survey duration and scope are considered entirely satisfactory based on the following considerations:

- The vantage points provide comprehensively coverage of proposed turbine locations in accordance with SNH Guidance.
- Surveying has been ongoing within the study area for two and a half years. This exceeds the two-year recommended duration of survey (SNH, 2017) which is typically considered best practice.
- There is no evidence to suggest that the Proposed Development is on a migratory or commuting route for bird species therefore no requirement for night time bird surveys were identified.

8.2.6.1 Mitigation

The development has been designed to specifically avoid, reduce and minimise effects on all Ornithological Receptors. Where potential effects on KORs are predicted, mitigation has been prescribed to avoid, reduce and remove 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 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.

8.2.6.2 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 difficulties (for example technical deficiencies or lack of knowledge) were encountered while compiling the required information. No significant limitations in the scope, scale or context of the assessment have been identified.

8.3 Baseline Conditions and Receptor Evaluation

8.3.1 Identification of Designated Sites within the Likely Zone of Influence of the Development

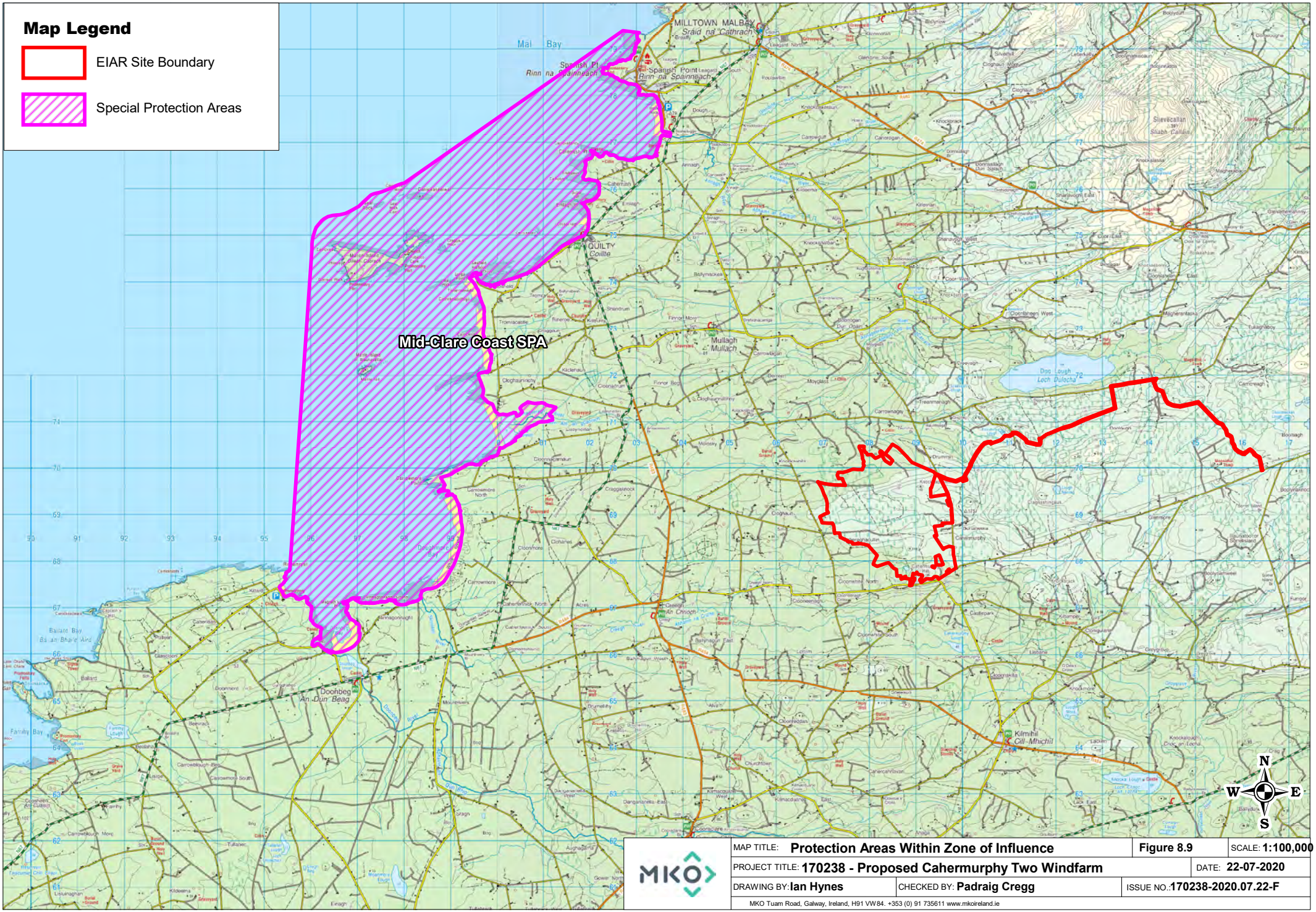
A screening assessment and Natura Impact Statement were prepared to provide the competent authority with the information necessary to complete an Appropriate Assessment for the Proposed Development in compliance with Article 6(3) of the Habitats Directive.

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 screening assessment findings with regard to Special Protection Areas. A summary of key assessment findings with regard to Special Areas of Conservation is provided in Chapter 7 of this EIAR.

Using GIS software, sites designated for nature conservation within the potential ZOI of the Proposed Development were identified. The ZOI was derived utilising a precautionary approach. Initially, sites within a 15-kilometre radius of the proposed works were identified. Then designated sites located outside the 15km buffer zone were taken into account and assessed. In this case, no potential for impacts outside the 15km buffer was identified.

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 the 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.

Only one SPA was located within the Likely Zone of Influence of the development, which is listed below in Table 8-8 and illustrated on Figure 8.9.



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MAP TITLE: **Protection Areas Within Zone of Influence**		**Figure 8.9**	SCALE: **1:100,000**
PROJECT TITLE: **170238 - Proposed Cahermurphy Two Windfarm**			DATE: **22-07-2020**
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Table 8-8 Designated Sites in the Zone of Influence

European Sites and distance from proposed development	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 05/08/2020	Conservation Objectives	Likely Zone of Impact Determination
Special Protection Area			
Mid Clare Coast SPA (004182) 5.8 km to the west of the development site.	› Cormorant (*Phalacrocorax carbo*) [A017] › Barnacle Goose (*Branta leucopsis*) [A045] › Ringed Plover (*Charadrius hiaticula*) [A137] › Sanderling (*Calidris alba*) [A144] › Purple Sandpiper (*Calidris maritima*) [A148] › Dunlin (*Calidris alpina*) [A149] › Turnstone (*Arenaria interpres*) [A169] › Wetland and Waterbirds [A999]	Detailed conservation objectives for this site (Version 1, September 2014) were reviewed as part of the assessment and are available at www.npws.ie	There will be no direct effects as the proposed development is located outside of the designated site. This SPA is located hydrologically downstream of the development. Therefore, taking a precautionary approach, a potential pathway for indirect effects on the QI 'Wetland and Waterbirds [A999]' was identified, in the form of deterioration of surface water quality resulting from pollution, associated with the construction and operational phases of the development. The proposd development does not provide suitable supporting habitat for any of the SCI bird species for which the SPA is designated. Therefore there is no potential for significant indirect effects as a result of disturabance. This site is considered to be **within the Likely Zone of Impact** and further assessment is required.
Nationally Designated Sites			
Other than sites, which are encompassed by the above SPA list, no nationally designated sites of ornithological significance occur within the potential ZOI.			

8.3.2 Breeding and Wintering Bird Atlas Records

'Bird Atlas 2007-2011: 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 R06 and R07. Table 8-109 shows those species recorded in the relevant hectads (R06, R07) in the breeding 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 8-9 Breeding Bird Atlas Data (Hectads R06/R07)

Species Name	Breeding Atlas 68-72		Breeding Atlas 88-91		Breeding Atlas 07-11		Conservation Status
	R06	R07	R06	R07	R06	R07	
Hen Harrier *(Circus cyaneus)*	-	-	-	-	Conf	Pres	BD
Peregrine *(Falco peregrinus)*	-	-	Seen	-	-	-	BD
Corncrake *(Crex crex)*	Prob	Prob	-	Seen	-	-	BD
Common Tern *(Sterna hirundo)*	-	-	-	-	-	Pres	BD
Merlin (*Falco columbarius*)	-	Poss	-	-	-	-	BD
Dunlin (*Calidris Alpina*)	-	-	-	-	-	Pres	BD
Whooper Swan (*Cygnus cygnus*)	-	-	-	-	-	Pres	BD
Bar-tailed godwit (*Limosa lapponica*)	-	-	-	-	-	Pres	BD
Sandwich Tern (*Sterna sandvicensis*)	-	Poss	-	Seen	-	Pres	BD
Golden plover (*Pluvialis apricaria*)	-	-	-	-	-	Pres	BD
Lapwing (*Vanellus vanellus*)	-	-	-	Conf	-	Pres	RL
Red Grouse *(Lagopus lagopus)*	Prob	Prob	-	-	-	-	RL

Species Name	Breeding Atlas 68-72		Breeding Atlas 88-91		Breeding Atlas 07-11		Conservation Status
	R06	R07	R06	R07	R06	R07	
Barn Owl (Tyto Alba)	Prob	-	-	-	-	-	RL
Black-headed Gull *(Larus ridibundus)*	-	Conf	-	-	Pres	Pres	RL
Herring Gull (Larus argentatus)	-	Prob	-	Seen	Pres	Pres	RL
Woodcock *(Scolopax rusticola)*	-	-	-	-	Poss	-	RL
Curlew *(Numenius arquata)*	Prob	Prob	Conf	Seen	Pres	Pres	RL
Redshank *(Tringa totanus)*	-	Prob	-	-	Pres	Pres	RL
Tufted Duck *(Aythya fuligula)*	-	-	-	-	Poss	Poss	RL
Meadow Pipit *(Anthus pratensis)*	Conf	Conf	Conf	Conf	Conf	Conf	RL
Grey Wagtail *(Motacilla cinerea)*	Conf	Prob	Conf	Conf	Conf	Conf	RL
Yellowhammer *(Emberiza citrinella)*	Conf	Conf	-	-	-	-	RL

Pres = present; Seen = recorded; Poss = possible breeding; Prob = probable breeding; Conf = confirmed breeding; - = not-recorded. Conservation Status; BD – Annex I of the Birds Directive, RL – BOCCI Red Listed

Table 8-10 shows those species recorded in the relevant hectads (R06, R07) 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 8-10 Wintering Bird Atlas Data (Hectads R06/R07)

Species Name	Wintering Atlas 81-84		Wintering Atlas 07-11		Conservation Status
	R06	R07	R06	R07	
Hen Harrier *(Circus cyaneus)*	Pres	-	Pres	Pres	BD
Peregrine *(Falco peregrinus)*	-	Pres	-	-	BD
Merlin (*Falco columbarius*)	Pres	-	-	-	BD
Dunlin (*Calidris Alpina*)	-	Pres	-	Pres	BD
Whooper Swan (*Cygnus cygnus*)	-	Pres	Pres	Pres	BD
Red - throated diver (*Gavia Stellata*)	-	Pres	-	-	BD

Species Name	Wintering Atlas 81-84		Wintering Atlas 07-11		Conservation Status
	R06	R07	R06	R07	
Bar-tailed godwit (*Limosa lapponica*)	-	Pres	-	Pres	BD
Golden plover (*Pluvialis apricaria*)	-	Pres	-	Pres	BD
Little gull (*Larus minutus*)	-	-	-	Pres	BD
Chough (*Pyrrhocorax pyrrhocorax)*	-	-	-	Pres	BD
Lapwing (*Vanellus vanellus*)	Pres	Pres	Pres	Pres	RL
Black-headed Gull *(Larus ridibundus)*	Pres	Pres	Pres	Pres	RL
Herring Gull (*Larus argentatus*)	-	Pres	-	Pres	RL
Curlew *(Numenius arquata)*	Pres	Pres	-	Pres	RL
Redshank *(Tringa totanus)*	-	Pres	-	Pres	RL
Meadow Pipit *(Anthus pratensis)*	Pres	Pres	Pres	Pres	RL
Grey Wagtail *(Motacilla cinerea)*	Pres	-	Pres	-	RL
Meadow Pipit *(Anthus pratensis)*	Pres	Pres	Pres	Pres	RL

Present = recorded; - = not-recorded. Conservation Status; BD – Annex I of the Birds Directive, RL – BOCCI Red Listed

8.3.3 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 Wind Farm Site is located within a zone of low sensitivity to windfarm development.

8.3.4 Irish Wetland Bird Survey (IWeBS) Records

The study area is not located in close proximity to any IWeBS site. The nearest site is located approximately 7.4km to the west of the development site boundary. Data from IWeBS sites in County Clare 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:

- Ballyallia Lake
- Ballycor Lough
- Carra Polje
- Castlelough
- Corofin Wetlands
- Dromore Lakes (Clare)

- Farrihy Lough
- Inagh River
- Knockaunroe/Rinnamona
- Liscannor Bay (Liscannor, Rinanoughter)
- Lough Atorick
- Lough Girroge
- Lough Graney
- Lough O'Grady
- Mid-Clare Coast (Mal Bay – Doonbeg Bay)
- Poulataggle
- Pouleenacoora
- River Shannon (Lower)
- Scariff area
- Shannon & Fergus Estuary
- South East Clare Lakes
- Tullaha Lough
- Turloughmore (Clare)

8.3.5 NPWS Rare and Protected Species Dataset

An information request was sent to the NPWS requesting records from the Rare and Protected Species Database. The sections below provide the records obtained from the NPWS (21st March 2019) regarding rare and protected bird species. The NPWS were contacted via email on the 26/07/2019, prior to finalising this EIAR chapter, and it was confirmed that the records provided below are the most up to date as of December 2019.

Hen Harrier

Table 8-11 below provides the NPWS records for Hen Harrier within defined buffer distances of the centroid of the Wind Farm Site (Irish Grid coordinates: x=108458, y=169005).

Table 8-11 NPWS Hen Harrier Records (December 2019)

Year	0-1km around the centroid (onsite)	1-3km around the centroid	3-5km around the centroid
2015	1 record of confirmed breeding 1 record of possible breeding	No Records	1 record of confirmed breeding
2010	2 records of confirmed breeding	2 confirmed breeding sites and 3 add. sightings recorded	No Records
2003	No Records	1 confirmed breeding site recorded	No Records

Department of Culture, Heritage and the Gaeltacht

The Department's Development Application Unit (DAU) consultation response was received on the 19th of July 2019, it stated that hen harrier had been recorded breeding within the site boundary and that suitable breeding habitat for curlew was also present. It was recommended that survey work should be undertaken for these two species.

8.3.6 Hen Harrier

On the 21st of June 2018, a consultation response email was received from the NPWS. In this response, the proposed development was identified to be located within a non-designated regionally important zone for hen harrier.

In 2016 the NPWS prepared an unpublished post hoc analysis report of the 2015 Hen Harrier Survey which identified a range of relatively important yet non-designated areas for breeding hen harriers. The proposed wind farms site is located in the non-designated area north and west Clare. Summary data for this non-designated area is provided in Table 8.12. A population of sixteen pairs was recorded from the north and west Clare area in 2010. Eight pairs were identified in 2015 which correlates to a 50% decrease in occupancy between 2010 and 2015.

Table 8-12 Summary of 2015 National Survey data for north and west Clare

Confirmed pairs	Possible pairs	Total number of territories	% of national population	Total number of young	Productivity/ successful pairs
3	5	8	5.1%	2	2.0

8.4 Field Survey Results

A comprehensive list of all bird species recorded during surveys is provided in Table 1-1 of Appendix 8-1. The target species listed below were recorded within the zone of influence of the Wind Farm Site during the ornithological surveys between April 2017 and September 2019. The list is ordered in accordance with conservation significance: Annex I species, Red listed species and raptors.

- Golden Plover
- Hen Harrier
- Merlin
- Peregrine Falcon
- Common Tern
- Lapwing
- Curlew
- Black-headed Gull
- Cormorant
- Red Grouse
- Woodcock
- Herring Gull
- Tufted Duck
- Buzzard
- Sparrowhawk
- Kestrel

- Snipe
- Meadow Pipit
- Grey Wagtail

The following sections describe the observations of each target species under the individual survey headings. Survey data and mapping for each target species is provided in the technical appendices.

Appendix 8-3 presents results in summary tables including:

- 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.
- Summary of observations at Potential Collision Height for target species during vantage point watches.
- Summary of the monthly distribution of flight activity recorded for the non-target species during the vantage point watches.
- 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 distribution of target species during Winter Transect Surveys.
- Summary of monthly distribution of non-target species during Winter Transect Surveys.

8.4.1 Golden Plover

Raw survey data for Golden plover is provided in Appendix 8-4. Results summary tables are present in Appendix 8-3.

Vantage Point Surveys

Golden plover were recorded on two occasions during Vantage Point Surveys (see Appendix 8-4, Figure 8.1.1). Both observations were of flocks of birds in flight at PCH. On the 3rd of December 2018 a flock of 25 golden plover were observed in flight within 500m of the site boundary for 260 seconds at PCH. On the 25th of March 2018 a flock of 30 Golden plover were observed in flight at PCH for 20 seconds. There were no observations within the Wind Farm Site or 500m of the proposed turbines. Both observations were recorded within 500m of the Wind Farm Site.

Incidental Observations

There were two incidental observations of golden plover recorded during Hen Harrier Roost Surveys in 2019. The first observation was recorded on the 15th of January 2019 from HHVP 3. On this occasion a flock of 100 birds were recorded circling near Creevagh Lough approximately 1.9km from the site before flying in a westerly direction. The second observation was also recorded from HHVP3 on the 4th of February 2019. On this occasion a flock of 25 birds were recorded in flight off site before settling in an area of bog (see Appendix 8-4, Figure 8.9.1).

There were no additional observations of this species recorded during any of the other comprehensive surveys.

8.4.2 Hen Harrier

Raw survey data for Hen harrier is provided in Appendix 8-4. Results summary tables are presented in Appendix 8-3.

Vantage Point Surveys

Hen harrier was recorded on 22 occasions during Vantage Point Surveys. (see Appendix 8-4, Figure 8.1.2). The vast majority of observations were recorded in open habitat on the eastern side of the site. There were no observations of more than one bird and two of these observations were at PCH. There were 20 observations within the Wind Farm Site. One observation was recorded within 500m of the Wind Farm Site and one observation was recorded approx. 930m from the Wind Farm Site. On 13 occasions hen harrier were recorded actively hunting, the remaining observations were of individual birds travelling through the viewshed. There were ten observations of male hen harrier recorded hunting in March 2018 close to VP2 to the east of the Wind Farm Site. On the 8th of September 2017 and the 4th of October 2018 individual juvenile birds were recorded in flight on site from VP2 and VP4 respectively.

Breeding Raptor Surveys

There were 21 observations of hen harrier recorded during Breeding Raptor Surveys. Only one of these observations was recorded within the Wind Farm Site. In addition, one flight was recorded within 500m of the Wind Farm Site and two flights within 2km. The remaining flights were recorded between 2km and 5km, to the east and north east of the Wind Farm Site. A pair of birds were recorded in a travelling flight on the 9th of May 2019 with the male approximately 80m in front of the female for the duration of the flight. This observation occurred approximately 1.1km from the Wind Farm Site near Cahermurphy

Lough. All other observations were of individual birds in flight. Hunting was observed on eleven occasions during this survey.

On the 18th of May 2019 a male hen harrier approached the surveyor whilst walking a transect to the east of the Wind Farm Site and alarm called while flying at a height of 1m. The bird then flew in the direction of a hen harrier territory to the south of Doo Lough. There were no further observations of this bird for the remainder of that day's surveying. The bird was recorded approximately 4.4km from the nearest proposed turbine. The Doo Lough hen harrier territory recorded during 2018 surveys is over 3.6km from the Wind Farm Site and is crossed by the Grid Connection Route. See Appendix 8-4, Figure 8.4.1 for hen harrier flights during Breeding Raptor Surveys and Figure 1-1 in confidential appendix 8.7 for nest locations and associated activity.

Hen Harrier Roost Survey

There were seven observations of hen harrier recorded during designated Hen Harrier Roost Surveys. A pair were recorded on the 13th of December 2018. All other observations were of individual birds in flight. On the 11th of December 2017 a male flew in to roost in an area of cutover bog c. 210m from the development boundary and 840m from the nearest turbine location. On the 2nd of October 2018 an individual hen harrier went in to roost c. 400m to the northwest of the Wind Farm Site near an area of conifer forestry. On the 23rd of January 2018 a female was recorded going in to roost in an area of conifer plantation/cutover bog c. 580m to the north west of the Wind Farm Site and greater than 1.1km from the nearest turbine location. On the 13th of December 2018 a male and female were recorded flying in to roost in an area of bog c. 3km to the east of the Wind Farm Site. On the 28th of February 2018 an adult male was observed in flight c. 200m from the Wind Farm Site but not observed going to roost.

Sites where roosting hen harrier were recorded were revisited, however no roost sites were found to be active on subsequent visits. There were no other records of roosting hen harrier during dedicated Hen Harrier Roost Surveys. The remaining observations were of individuals hunting or in flight. Two of these records involved birds flying across the western margins of the Wind Farm Site. The remaining flights were recorded outside the Wind Farm Site.

See Appendix 8-4, Figure 8.7.1 for hen harrier flights recorded during designated hen harrier roost surveys. A map showing all hen harrier roost locations and associated flight activity can be seen in confidential Appendix 8-7, Figure 1-2

Winter Walkover Surveys

Hen harrier were observed on three occasions during this survey. On the 29th of January 2019 two males were observed flying in to roost in an area of bog c. 350m to the north east of the Wind Farm Site. On the 4th of March 2019 a male and female were observed flying over conifer forestry to the north east of Caheraghcullin (onsite). On the 10th of March 2019 an individual was observed in a low flight c. 1.7km from the Wind Farm Site. See Appendix 8-4, Figure 8.8.1. A map showing all hen harrier roost locations and associated flight activity can be seen in confidential Appendix 8-7, Figure 1-3.

There were no additional observations of this species recorded during any of the other surveys.

8.4.3 Merlin

Raw survey data for merlin is provided in Appendix 8-4. Results summary tables are present in Appendix 8-3.

Vantage Point Surveys

Merlin were only recorded once during Vantage Point Surveys between April 2017 and September 2019 (see Appendix 8-4, Figure 8.1.3). On the 14th of May 2018 an adult male was observed from VP3 hunting meadow pipits low over blanket bog. This individual was recorded c. 70m from the Wind Farm Site and c. 500m to the east of the nearest proposed turbine location.

Winter Walkovers Surveys

Merlin were also recorded once during Winter Walkover Surveys (see Appendix 8-4, Figure 8.8.2). On the 4th of March 2019 a male was recorded flying through an area of recently felled woodland/wet grassland within the Wind Farm Site. There were no other records of this species during Winter Walkover Surveys.

Incidental Observations

There were two incidental observations of merlin recorded during Hen Harrier Roost Surveys in 2017 & 2019. The first observation was recorded on the 20th of November 2017 from HHVP10 (greater than) 500m to the north east of the Wind Farm Site. On this occasion an individual adult male was recorded flying towards a block of forestry near Drummin to the east of the Wind Farm Site. The second incidental observation was recorded on the 15th of January 2019 from HHVP3. On this occasion an individual female was observed perched off site. This individual was observed near Doo Lough for twenty-five minutes before flying west out of view. See Appendix 8-4, Figure 8.9.2 for locations of Merlin recorded as incidental observations.

There were no additional observations of this species recorded during any of the other surveys.

8.4.4 Peregrine Falcon

Raw survey data for peregrine falcon is provided in Appendix 8-4. Results summary tables are present in Appendix 8-3.

Vantage Point Surveys

Peregrine falcon were recorded on two occasions during Vantage Point Surveys between April 2017 and September 2019 (see Appendix 8-4, Figure 8.1.4). The first observation occurred on the 30th of January 2019 from VP2. This observation was of a female flying below PCH over agricultural grassland within the Wind Farm Site. The second observation was also recorded in flight over the Wind Farm Site. On the 29th of April 2019, an individual was recorded from VP2 soaring at PCH for 30 seconds before rising above PCH (175m+) for a further 120 seconds.

Breeding Raptor Surveys

Peregrine falcon were only recorded once during Breeding Raptor Surveys (see Appendix 8-4, Figure 8.4.2). On the 24th of July 2017, an adult male and juvenile were observed hunting to the north west of the site boundary before flying south and out of view. These birds were recorded c. 2.4km from the Wind Farm Site.

Incidental Observations

Peregrine falcon were recorded once during Hen Harrier Roost Surveys at the site. The observation was of an individual female recorded on the 1st of September 2019 from HHVP4.

There were no additional observations of this species recorded during any of the other surveys.

8.4.5 Common Tern

Raw survey data for common tern is provided in Appendix 8-4. Results summary tables are present in Appendix 8-3.

Vantage Point Surveys

Common tern was recorded only once during Vantage Point Surveys throughout the entire survey period (see Appendix 8-4, Figure 8.1.5). The observation was recorded on the 7th of September 2017 from VP3 over the Wind Farm Site. On this occasion an individual was observed on site flying due north over conifer plantation for 44 seconds at PCH.

There were no additional observations of this species recorded during any of the other surveys.

8.4.6 Curlew

Raw survey data for curlew is provided in Appendix 8-4. Results summary tables are present in Appendix 8-3.

Incidental Observations

Curlew were only recorded once during the entire survey period between April 2017 and September 2019 (see Appendix 8-4, Figure 8.9.2). On the 24th of July 2017 during a breeding raptor survey a flock of 12 birds were recorded in flight, travelling east to west, approximately 900m from the Wind Farm Site.

There were no additional observations of this species recorded during any of the other surveys.

8.4.7 Herring Gull

Raw survey data for herring gull is provided in Appendix 8-4. Results summary tables are present in Appendix 8-3.

Vantage Point Surveys

Herring gull were recorded on 76 occasions during Vantage Point Surveys of the site. The majority (54) of these flights were recorded during the three breeding seasons surveyed (2017, 2018 and 2019). Of these flights 42 were recorded during the 2017 breeding season. The maximum flock size was c.40 individuals. Flights were recorded at PCH on 38 occasions and flights were recorded over the Wind Farm Site on 51 occasions. On 66 occasions birds were observed commuting through the area. While a total of four observations involved foraging birds. All observations of feeding birds were recorded on site during surveys from VP2 near Cahermurphy Hill. (see Appendix 8-4, Figure 8.1.6).

On the 7th of June 2017, 15 birds were recorded feeding in agricultural grassland from VP2. This observation was recorded within the Wind Farm Site and within c.450m of the nearest proposed turbine.

Breeding Walkover Surveys

Herring gull were observed on one occasion during Breeding Walkover Surveys of the site. This observation was recorded on the 1st of April 2019. A total of seven birds were recorded flying over an area of cutover bog/conifer plantation to the north west of the Wind Farm Site. There were no further observations of this species recorded during Breeding Walkover Surveys (see Appendix 8-4, Figure 8.3.1).

Winter Walkover Surveys

Herring gull were observed on four occasions during Winter Walkover Surveys. Observations were recorded on the 2nd of October 2018 and 29th of January 2019 (see Appendix 8-4, Figure 8.8.3). One of these flights on the 2nd of October 2018 was recorded approx. 120m from the development boundary All other flights were recorded more than 200m to the east of the Wind Farm Site.

Incidental Observations

Herring gull were observed on three occasions as an incidental observation between April 2017 and September 2019. On the 16th of April 2018 two birds were recorded flying off site from west to east to the north of the Wind Farm Site. On the 20th of March 2019 a flock of seven birds was recorded in flight on site during a hen harrier roost survey from HHVP5. On the 21st of March 2019 three birds were observed in flight off site during a hen harrier roost watch from HHVP10. See Appendix 8-4, Figure 8.9.4) for locations of herring gull recorded as incidental observations.

There were no additional observations of this species during any of the other comprehensive surveys.

8.4.8 Lapwing

Raw survey data for lapwing is provided in Appendix 8-4. Results summary tables are present in Appendix 8-3.

Winter Walkover Surveys

Lapwing were observed only once during the entire survey period between April 2017 and September 2019. On the 2nd of October 2018 during a winter walkover survey, three birds were recorded flying north over an area of bog/wet grassland within the Wind Farm Site near Caheraghacullin. There were no further records of this species during Winter Walkover Surveys (see Appendix 8-4, Figure 8.8.4).

There were no additional observations of this species recorded during any of the other surveys.

8.4.9 Black Headed Gull

Raw survey data for black-headed gull is provided in Appendix 8-4. Results summary tables are present in Appendix 8-3.

Vantage Point Surveys

Black-headed gull were recorded on four occasions during Vantage Point Surveys between April 2017 and September 2019 (see Appendix 8-4, Figure 8.1.7). All observations were recorded during September 2019 surveys from VP1 and VP4. On the 3rd of September 2019 there were two observations of black-headed gull recorded from VP1. Both observations involved small flocks commuting over the site below PCH. On the 4th of September 2019 two observations were recorded

from VP4. As was the case on the previous day, two small flocks were recorded flying across the site below PCH. Flock size ranged from five to eighteen individuals.

There were no additional observations of this species recorded during any of the other surveys.

8.4.10 Cormorant

Raw survey data for cormorant is provided in Appendix 8-4. Results summary tables are present in Appendix 8-3.

Vantage Point Surveys

Cormorant was recorded only once during Vantage Point Surveys (see Appendix 8-4, Figure 8.1.8). The observation was recorded on the 2nd of August 2017 from VP1. On this occasion an individual bird was observed flying over agricultural grassland below PCH. This observation was recorded approximately 180m to the north of the Wind Farm Site flying south towards a section of the Annageeragh River.

There were no additional observations of this species recorded during any of the other comprehensive surveys.

8.4.11 Woodcock

Raw survey data for woodcock is provided in Appendix 8-4. Results summary tables are present in Appendix 8-3.

Breeding Woodcock Surveys

In total woodcock were only recorded on a single occasion during designated Breeding Woodcock Surveys (see Appendix 8-4, Figure 8.5.1). On the 27th of June 2018, the surveyor heard two woodcock calling (roding was not confirmed by the surveyor). The surveyor did not get a visual of the birds and recorded the observation c.730m to the north east of the Wind Farm Site. No woodcock were recorded during designated Breeding Woodcock Surveys in 2017 or 2019.

There were no additional observations of this species recorded during any of the other surveys.

8.4.12 Tufted Duck

Raw survey data for tufted duck is provided in Appendix 8-4. Results summary tables are present in Appendix 8-3.

Incidental Observations

Tufted duck were only recorded on a single occasion during surveys between April 2017 and September 2019 (see Appendix 8-4, Figure 8.1.3). On the 15th of January 2019 during a hen harrier roost survey, a flock of 10 birds was observed on Doo Lough to the east of the Wind Farm Site. At its nearest point Doo Lough is c.2.5km from the Wind Farm Site. See Appendix 8-4, Figure 8.9.5) for locations of Tufted Duck recorded as incidental observations.

There were no additional observations of this species recorded during any of the other surveys.

8.4.13 Buzzard

Raw survey data for buzzard is provided in Appendix 8-4. Results summary tables are present in Appendix 8-3.

Vantage Point Surveys

Buzzard were recorded on nine occasions during Vantage Point Surveys throughout the entire survey period April 2017 and September 2019 (see Appendix 8-4, Figure 8.1.9). Individual birds in flight were observed on seven occasions. On two occasions a pair of buzzards were observed in flight. On the 12th of June 2019 a pair were observed soaring over suitable nesting habitat. The area is located within the Wind Farm Site, c. 200m to the east of the nearest turbine location.

Breeding Raptor Surveys

Buzzard were only recorded once during Breeding Raptor Surveys (see Appendix 8-4, Figure 8.4.3). On the 21st of June 2019 an adult was observed soaring at PCH. This bird was recorded c. 40m to the north west of the Wind Farm Site, soaring over a block of forestry. No breeding activity was recorded for this species during Breeding Raptor Surveys. There were no further observations of this species during Breeding Raptor Surveys

Breeding Walkover Surveys

Buzzard were recorded twice during Breeding Walkover Surveys (see Appendix 8-4, Figure 8.3.2). Both observations were recorded during the 2019 breeding season. On the 18th of April 2019 a male was observed flying in to a perch in an area of cutover bog/conifer plantation. On the 8th of June 2019 a buzzard was observed perched in a tree in an area of conifer/cutover bog. There were no other records of this species recorded during Breeding Walkover Surveys. Both observations were recorded within the Wind Farm Site.

Winter Walkover Surveys

Buzzard was observed on a single occasion during Winter Walkover Surveys between 2017 and 2019. On the 4th of March 2019, a buzzard was recorded within the Wind Farm Site in flight over conifer forestry (see Appendix 8-4, Figure 8.8.5).

Incidental Observations

Buzzard were recorded as an incidental observation on one occasion throughout the entire survey period from April 2017 to September 2019. The observation was recorded during a hen harrier roost survey on the 30th of March 2019. Two birds were recorded soaring together above HHVP4 c. 30m from the Wind Farm Site. See Appendix 8-4, Figure 8.9.6) for locations of buzzard recorded as incidental observations.

8.4.14 Sparrowhawk

Raw survey data for sparrowhawk is provided in Appendix 8-4. Results summary tables are present in Appendix 8-3.

Vantage Point Surveys

Sparrowhawk were recorded on 18 occasions during Vantage Point Surveys between April 2017 and September 2019 (see Appendix 8-4, Figure 8.1.3). All observations were of individual birds in flight or hunting. Hunting was observed on ten occasions while birds flying through the site were observed on twelve occasions. Sparrowhawk were recorded flying at PCH on a single occasion for a total duration of five seconds.

Breeding Raptor Surveys

Sparrowhawk were recorded on 14 occasions during Breeding Raptor Surveys (see Appendix 8-4, Figure 8.4.4). On all but one occasion these observations involved lone birds. On a single occasion, two birds were recorded flying low into a patch of scrub. This species was observed hunting on seven occasions while the remainder of the observations were of birds in flight. Four observations were recorded within the Wind Farm Site, two observations were recorded within 500m and the remaining observations were recorded between 700m and 3.5km from the Wind Farm Site. No breeding activity was recorded for this species during Breeding Raptor Surveys.

Breeding Walkover Surveys

Sparrowhawk were recorded on six occasions during Breeding Walkover Surveys throughout the entire survey period. Individual birds were observed in flight during five of these observations. On the 18th of April 2018 a pair was observed soaring over an area of cutover bog/conifer forestry. This species was observed hunting on three occasions. Five observations were recorded within the Wind Farm Site and one was recorded within 500m. No breeding activity was observed for this species during Breeding Walkover Surveys. However, a pair was recorded in suitable breeding habitat (see Appendix 8-4, Figure 8.3.3).

Winter Walkover Surveys

Sparrowhawk were recorded on four occasions during Winter Walkover Surveys (see Appendix 8-4, Figure 8.8.8). On each of the four occasion only one individual was recorded. Three observations were recorded on the 5th of October 2017 while the last observation of this species was recorded on the 20th of December 2017. Two observations were recorded within the Wind Farm Site and two observations were recorded offsite. All winter walkover observations were recorded in early winter 2017.

Incidental Observations

Sparrowhawk recorded on a single occasion as an incidental observation throughout the entire survey period. The observation was recorded during a hen harrier roost survey on the 21st of March 2019. A female was recorded hunting from HHVP10 c. 6km from the Wind Farm Site. See Appendix 8-4, Figure 8.9.7) for locations of Sparrowhawk recorded as incidental observations.

There were no additional observations of this species recorded during any of the other surveys.

8.4.15 Kestrel

Raw survey data for kestrel is provided in Appendix 8-4. Results summary tables are present in Appendix 8-3.

Vantage Point Surveys

Kestrel were recorded on 82 occasions during Vantage Point Surveys between April 2017 and September 2019 (see Appendix 8-4, Figure 8.1.11). Observations were spread throughout the breeding and non-breeding seasons. All observations were of individual birds in flight and 41 of these flights were recorded within the Wind Farm Site. A total of 20 observations involved birds flying at PCH. Hunting was observed on 57 occasions. On the 5th of June 2019 a male kestrel was observed flying with prey in its talons towards a probable nest site. The probable nest site is located c. 450m to the east of the Wind Farm Site and in excess of 1.1km from the nearest turbine location. On the 3rd of January 2019 there were nine observations from VP04 all of which relate to the same individual female. See Appendix 8-4 figure 8.1.11.1 for location of the probable nest site recorded on the 5th of June 2019.

Breeding Raptor Surveys

Kestrel were recorded on 25 occasions during Breeding Raptor Surveys (see Appendix 8-4, Figure 8.4.5). Only lone birds were recorded. This species was observed hunting on 22 occasions while the remainder of the observations were of birds in flight. No breeding activity was recorded for this species during Breeding Raptor Surveys.

Breeding Walkover Surveys

Kestrel were recorded on six occasions during Breeding Walkover Surveys throughout the entire survey period (see Appendix 8-4, Figure 8.3.4). Individual birds were observed in flight during each of these observations. This species was observed hunting on three occasions during July surveys in 2017 and once on the 1st of April 2019. On the 13th and 14th of July 2017 individual kestrel were observed hunting on site. On the 1st of April 2019 a second kestrel was recorded in flight over the site. No breeding activity was observed for this species during Breeding Walkover Surveys.

Winter Walkover Surveys

Kestrel were recorded on eleven occasions during Winter Walkover Surveys (see Appendix 8-4, Figure 8.8.7). Only lone birds were recorded. Hunting was observed on nine occasions during winter walkover surveys with three of these observations recorded on site. The remaining observations relate to birds hunting, in flight or perching offsite.

Incidental Observations

There were three incidental observations of kestrel recorded throughout the entire survey period. On the 14th of November 2018 an individual bird was observed hunting on site during a hen harrier roost survey at HHVP5. On the 18th of December 2018 a male kestrel was observed hovering over the site during a Hen Harrier Roost Survey form HHVP5. On the 11th of March 2019 a female kestrel was observed hunting near Doo Lough during a Hen Harrier Roost Survey from HHVP4. See Appendix 8-4, Figure 8.9.8) for locations of Kestrel recorded as incidental observations.

There were no additional observations of this species recorded during any of the other surveys.

8.4.16 Snipe

Raw survey data for snipe is provided in Appendix 8-4. Results summary tables are present in Appendix 8-3.

Vantage Point Surveys

Snipe were recorded on eleven occasions during Vantage Point Surveys between April 2017 and September 2019 (see Appendix 8-4, Figure 8.1.12). Observations ranged from individuals to a flock of 16 birds. On three occasions snipe were observed in flight at PCH. On the 6th of February 2019 there were two incidences of snipe drumming from VP1. On the 25th of March 2018 a snipe was flushed by a hen harrier hunting around VP2 over agricultural grassland. Snipe were recorded within the Wind Farm Site on seven occasions.

On the 15th of May 2019 a snipe was heard from VP1. A snipe was heard chipping from an area of wet grassland.

Breeding Walkover Surveys

Snipe were recorded on 13 occasions during Breeding Walkover Surveys throughout the entire survey period. Eight of the 13 records involved individual birds while two birds were observed together on five occasions. In April 2017 there were four observations of two birds recorded together. On the 8th of April 2018 an individual was observed foraging on site near Cahermurphy Hill. On the 9th of April 2018 an individual bird was observed foraging off site and there were no further observations of snipe foraging. There was no evidence confirming breeding snipe recorded during Breeding Walkover Surveys.

Winter Walkover Surveys

Snipe were recorded on 11 occasions during Winter Walkover Surveys (see Appendix 8-4, Figure 8.4.1). Numbers of birds recorded ranged from individuals to a flock of 12 birds recorded on the 2nd of October 2018. All records were of birds flushed and nine of the 11 observations were recorded on site.

Incidental Observations

Snipe were recorded as an incidental observation on five occasions throughout the entire survey period. Four of these observations were recorded in 2017 during Hen Harrier Roost Surveys. On the 11th of December 2017 a flock of 12 snipe were recorded flying across the site. On the 13th of February a flock of five snipe were recorded as the surveyor made his way to VP3.

There were no additional observations of this species during any of the other comprehensive surveys.

8.4.17 Passerines (Red Listed)

Raw Survey data for red listed passerine species is provided in Appendix 8-4. Results summary tables are present in Appendix 8-3.

The BoCCI Red listed species meadow pipit and grey wagtail were recorded during the surveys undertaken.

8.4.18 Non-Core Bird Data

As previously discussed in Section 8.2.4.3, a number of surveys were undertaken as part of a larger proposed development area, which encompassed the current study area and a discrete parcel of land to the south of Doo Lough. This area was removed from the proposed development area in large part due to the identification of an active hen harrier territory. The non-core bird data and all the associated digitised flight lines are provided in Appendix 8-5. This data provides useful supplementary information on distribution and abundance of target species in the wider surroundings of the proposed development. In particular, the hen harrier breeding territory to the south of Doo lough was located during these surveys.

Hen Harrier

During the 2017 breeding season hen harrier bred in a section of young forestry approximately 1.4km to the south east of Doo Lough and in the 2018 breeding season hen harrier was recorded to have bred in a section of young forestry approximately 1km south of Doo Lough. Whilst hen harrier were again recorded in this area early in the 2019 season, breeding was not successful. These are the most recently active nest sites that have been located within the wider surroundings of the Wind Farm Site. It's location is provided in confidential Appendix 8-7.

In addition, hen harrier were recorded roosting at Booltiagh wind farm over 7km from the Wind Farm Site. The locations of these roosts are provided in confidential Appendix 8-7.

Other Species of Note

In addition to the observations of hen harrier mentioned above, surveyors also recorded golden plover, whooper swan, merlin, peregrine, teal, little grebe, goshawk, sparrowhawk, kestrel, cormorant, snipe, herring gull, black headed-gull meadow pipit and buzzard.

Golden plover activity was recorded on five occasions at Lough Nacrag. Flocks sizes ranged from 6 to 45 birds. A flock of 17 birds were recorded on the 21st of April 2018 landing in blanket bog. This species was not observed breeding during any of the surveys at the site. In January a flock of six birds were observed roosting on bog c.2.5km away from the Wind Farm Site.

A flock of seven whooper swan were recorded in November 2017 flying towards Doo Lough c. 1.9km from the Wind Farm Site. There were no other observations of this species recorded during the extensive surveys at this site.

Merlin were recorded on two occasions in the vicinity of Doo Lough c. 2km from the Wind Farm Site. On both occasions an individual female was observed in flight.

Peregrine were recorded on three occasions during additional surveys to the east of the Wind Farm Site. On each occasion only one bird was recorded. In May 2018 a peregrine was recorded in flight to the east of Lough Nacrag c.2.2km from the Wind Farm Site. In January and February of 2019 individual peregrine were observed in flight within 500m of the Wind Farm Site.

Kestrel were observed regularly during additional surveys to the east of the Wind Farm Site and a breeding territory was confirmed in June 2017 within the Wind Farm Site to the west of Cahermurphy Hill. No further breeding territories were observed in the subsequent additional surveys.

Sparrowhawk were also observed regularly to the east of the Wind Farm Site. On two occasions breeding was confirmed c.4.6km and c.6.9km to the east of the Wind Farm Site There were no further records of breeding during any other subsequent additional surveys.

Teal were recorded on three separate occasions during surveys to the east of the Wind Farm Site. Two observations came during surveys in April 2017 and one observation was recorded in April 2018. On

the 18th of April three Teal were observed displaying at Boleybeg lake c. 1.7km from the Wind Farm Site. No other observations of this species were recorded during surveys to the east of the Wind Farm Site

Little grebe were observed on seven occasions during surveys to the east of the Wind Farm Site . All observations were recorded during the breeding seasons of 2017 and 2018. No breeding activity was observed. All observations were recorded in excess of 2.4km from the Wind Farm Site near Lough Nacrag.

Goshawk were observed on one occasion c. 3.5 km from the Wind Farm Site south of Doo Lough.

Other species recorded during additional surveys to the east of the Wind Farm Site include cormorant, herring gull, black-headed gull, buzzard, snipe, meadow pipit and whimbrel.

The above observations have been digitised and are provided in Appendix 8-5.

Pre April 2017-Ornithological Surveys

Ornithological surveying has been ongoing in the Cahermurphy area since 2010. During the 2010 breeding season three hen harrier territories were recorded within the boundary of what is now the Wind Farm Site. In 2014 four hen harrier territories were recorded. All of which were recorded outside the Wind Farm Site. The 2014 nest locations were as follows:

- Two were located approximately 1km west of the Wind Farm Site;
- One was located less than 1km south of Doo Lough; and
- The final territory was recorded approximately 4km west of Doo Lough.

The indicative locations of these historic hen harrier territories are provided in Confidential Appendix 8-7

8.5 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 0. 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 has been derived following a review of I-WeBS sites in County Clare.

8.5.1 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 largest flock numbered 100 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 County Clare I-WeBS sites was conducted. The following mean count values have been recorded for Clare I-WeBS sites over the most recent five-year period, i.e. for the period 2011/2012 – 2015/16:

- Ballyallia Lake = 0
- Ballycar Lough = 0

- Carran Polje = 0
- Castlelough = 22
- Corofin Wetlands = 53
- Dromore Lakes (Clare) = 0
- Farrihy Lough = 0
- Innagh River = 0
- Knockaunroe/Rinnamona = 0
- Liscannor Bay (Liscannor-Rinnoughter) = 283
- Lough Atorick = 0
- Lough Girroge = 0
- Lough Graney = 0
- Lough O'Grady = 0
- Mid-Clare Coast (Mal Bay-Doonbeg Bay) = 240
- Poulataggle = 0
- Pouleenacoora = 0
- River Shannon Lower = 0
- River Shannon Lower (Aerial) = 0
- Scarriff Area = 0
- Shannon and Fergus Estuary = 207
- Shannon and Fergus Estuary (Aerial) = 2356
- South East Clare Lakes = 0
- Tullaher Lough = 0
- Turloughmore = 0

There are golden plover records at six of the Clare I-WeBS sites from the most recent five-year survey period. The estimate mean wintering population from Clare I-WeBS sites is 3,161. It is acknowledged that I-WeBS counts underestimate the numbers of certain species (e.g. golden plover) as these species regularly forage away from wetland sites (Burke et al., 2018). Therefore, based on available information, a regularly occurring population of 31 birds (1% of Clare county population) is considered of County Importance.

There were only four observations of golden plover recorded throughout the entire survey period. All observations were recorded outside of the Wind Farm Site. A flock of County Importance was recorded on one occasion circling Creevagh Lough approximately 1.9km to the north east of the Wind Farm Site. And a flock of 30 golden plover were recorded c. 450m to the east of the Wind Farm Site.

No other flocks of county importance were recorded during the extensive suite of surveys undertaken between April 2017 and September 2019.

Breeding

The breeding distribution of this species is now restricted to the west (north of Co. Clare) and north-west of the country. No evidence of breeding activity was recorded.

8.5.2 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 observed within the study area during the winter months and a maximum of three winter roosts were recorded within 500m of the Wind Farm Site.

Taking a precautionary approach, it is assumed that the individuals recorded during the winter season are associated with a **Nationally/Internationally** important wintering population.

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. No breeding activity was recorded onsite, however foraging individuals were regularly recorded.

This species was observed on 29 occasions during the breeding season. It is considered that many of these flights were associated with a nest site to the south of Doo Lough. It is likely that the individuals recorded during the breeding season were associated with a **Nationally/Internationally** important population from the wider surroundings of the Wind Farm Site.

8.5.3 Merlin

As per the latest NPWS Article 12 reporting document, the estimated population of Merlin is between 200 – 400 pairs.

The species was recorded on four occasions throughout the entire survey period. Two of these observations involved birds onsite/within 500m of the Wind Farm Site. Taking a precautionary approach, 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.

8.5.4 Peregrine

The estimated national breeding population of peregrine falcon in Ireland is 425 breeding pairs as per the National Breeding Peregrine Survey 2017. No evidence of breeding was recorded within the study area. There were four observations of this species throughout the entire survey period: April 2017 to September 2019. Of these records, a bird was recorded flying at PCH on a single occasion. Taking a precautionary approach, 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.

8.5.5 Common Tern

There was only one observation of this species over the windfarm site. Numbers of ecological significance as per NRA criteria were not recorded. No evidence of breeding or roosting activity was recorded within the study area. One flight was recorded within the potential collision risk zone.

Taking a precautionary approach, the bird recorded was assigned **Local Importance (Higher Value)**.

8.5.6 Lapwing

This species was recorded on a single occasion between April 2017 and September 2019. Three lapwing were recorded flying across the Wind Farm Site. There is no evidence to suggest that this species utilises the local area with any regularity during either the winter or breeding season. Numbers of ecological significance as per NRA criteria were not recorded. No flights were recorded within the potential collision risk zone.

8.5.7 Curlew

There was only one observation of this species, which was recorded c.900m from the Wind Farm Site. These birds were recorded late in breeding season and were not considered to be part of a local breeding population. Numbers of ecological significance as per NRA criteria were not recorded. No evidence of breeding or roosting activity was recorded within the study area. No flights were recorded within the potential collision risk zone.

8.5.8 Herring Gull

This species is Red listed under BoCCI in Ireland. There were 57 observations of this species on or near the site during the breeding season. No breeding activity was observed within the development site or its surroundings during any of the extensive surveys of the site. The majority of birds observed during the breeding season were recorded flying across the site. It is considered likely that the birds recorded crossing the Wind Farm Site are associated with local coastal colonies. A review of the Bird Atlas (2007-11) revealed numerous instances of confirmed breeding along the Clare coastline, despite this, information on the county population of breeding herring gull was not readily available.

Taking a precautionary approach, the population recorded was assigned **Local Importance (Higher Value)**.

8.5.9 Cormorant

No evidence of breeding or roosting activity was recorded within the study area. Numbers of ecological significance as per NRA criteria were not recorded. The Wind Farm Site lacks the wetland habitats favoured by this species. No flights were recorded within the potential collision risk zone.

8.5.10 Woodcock

On the 27th of June 2018, the surveyor heard two woodcock calling c.730m to the north east of the Wind Farm Site. Numbers of ecological significance as per NRA criteria were not recorded. No evidence of breeding or foraging was recorded within the study area. No flights were recorded within the potential collision risk zone.

8.5.11 Black-headed Gull

This species is Red listed under BoCCI in Ireland. Over the course of a two day period, four small flocks of black-headed gull were recorded. There were no other observation of species recorded between April 2017 and September 2019.

Taking a precautionary approach, the population recorded was assigned **Local Importance (Higher Value)**.

8.5.12 Tufted Duck

This species was recorded on a single occasion c.2.5km to the east of the Wind Farm Site on Doo Lough. Numbers of ecological significance as per NRA criteria were not recorded. No evidence of breeding or roosting activity was recorded within the study area. No flights were recorded within the potential collision risk zone.

8.5.13 Buzzard

Buzzard is not listed on Annex I of the Birds Directive. The species is Green listed in Ireland (BoCCI). No confirmed breeding activity was recorded within a 5km radius of the site boundary. The birds recorded during the breeding season are likely to be associated with a breeding population from the wider area and were assigned **Local Importance (Higher Value)**.

8.5.14 Sparrowhawk

Sparrowhawk is not listed on Annex I of the Birds Directive. The species is Amber listed in Ireland (BoCCI). 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.

8.5.15 Kestrel

Kestrel is not listed on Annex I of the Birds Directive. The species is Amber listed in Ireland (BoCCI). A possible nest was recorded c. 450m from the Wind Farm Site. 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.

8.5.16 Snipe

Snipe are amber listed in Ireland during both the breeding and winter seasons (BoCCI). The birds recorded during the breeding season are likely to be associated with a breeding population from the local area and were assigned **Local Importance (Higher Value)**.

8.5.17 Passerines (Red Listed Species)

Grey Wagtail, Meadow Pipit are Red listed in Ireland. Both species were recorded during surveys. Taking a precautionary approach, the resident populations were assigned Local Importance (Lower Value).

8.6 Identification of Key Ornithological Receptors

Table 8-13 Avifaunal Receptor Evaluation and Selection Criteria Rational

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rational for inclusion/exclusion as KOR	KOR Yes/No
Golden Plover	Annex I, EU Birds Directive; BoCCI Red List & Irish Wildlife Act.	**Wintering** County Importance	This species was recorded in flight within 500m of the Wind Farm Site during winter months. The potential for habitat loss cannot be excluded. **An assessment of direct habitat loss is required.** Birds were recorded within 500m of the development site boundary. Taking a precautionary approach, **the potential for displacement exists**. This species was recorded flying within 500m of the development site within the potential collision risk zone. **A collision risk assessment is required.**	**Yes**
Hen Harrier	Annex I, EU Birds Directive; BoCCI Amber List & Irish Wildlife Act.	**All Seasons** National/International Importance	No breeding activity was recorded within Wind Farm Site between April 2017 and September 2019, however birds were regularly recorded foraging on site. In addition, the Grid Connection Route crosses the Doo Lough hen harrier territory. **An assessment of direct habitat loss is required.** Foraging birds were recorded onsite and a maximum of three winter roosts were recorded within 500m of the Wind Farm Site. In addition, the Grid Connection Route crosses the Doo Lough hen harrier territory. **An assessment of displacement effects is required**. This species was recorded flying over the development site within the potential collision risk zone. **A collision risk assessment is required.**	**Yes**
Merlin	Annex I, EU Birds Directive; BoCCI Amber List & Irish Wildlife Act.	**All Seasons** Local Importance (Higher Value)	The species was recorded on four occasions throughout the entire survey period. Two of these observations involved birds onsite/within 500m of the Wind Farm Site. **Taking a precautionary approach an assessment of potential displacement and habitat loss is required.**	**Yes**

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rational for inclusion/exclusion as KOR	KOR Yes/No
			This species was not recorded flying at possible collision height (PCH). An assessment of collision risk is not required.	
Peregrine Falcon	Annex I, EU Birds Directive; BoCCI Green List & Irish Wildlife Act.	**All Seasons** Local Importance (Higher Value)	There were four observations of this species throughout the entire survey period: April 2017 to September 2019. The potential for habitat loss, while minimal, cannot be excluded. **An assessment of displacement and direct habitat loss is required.** A bird was recorded flying at PCH on a single occasion. **Taking a precautionary approach, a collision risk assessment is required.**	**Yes**
Common Tern	Annex I, EU Birds Directive; BoCCI Amber List & Irish Wildlife Act.	**All Seasons** Local Importance (Higher Value)	The Wind Farm Site does not contain suitable breeding or foraging habitat for this species. The single observation of this species is considered an aberration. No pathways for significant direct or indirect habitat loss were identified. This species was recorded flying over the development area within the potential collision risk zone. **Taking a precautionary approach, a collision risk assessment is required.**	**Yes**
Curlew	BoCCI Red Listed (breeding and wintering).	**N/A**	This species was recorded on a single occasion between April 2017 and September 2019. A flock of 12 birds was recorded c. 900m from the Wind Farm Site. There is no evidence to suggest that this species utilises the local area during either the winter or breeding season. There is no potential for habitat loss or displacement. No pathways for significant direct or indirect effects were identified.	**No**

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rational for inclusion/exclusion as KOR	KOR Yes/No
Lapwing	BoCCI Red List (breeding and wintering) & Irish Wildlife Act.	**N/A**	This species was recorded on a single occasion between April 2017 and September 2019. Three lapwing were recorded flying across the Wind Farm Site. There is no evidence to suggest that this species utilises the local area with any regularity during either the winter or breeding season. No flights were recorded within the potential collision risk zone. There is no pathway for significant ecological effects.	**No**
Herring Gull	BoCCI Red Listed & Irish Wildlife Act.	**Breeding** Local Importance (Higher Value)	This species was recorded within the development site. Suitable foraging habitat is present along the margins of the site. The potential for direct habitat loss cannot be ruled out. **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 within the potential collision risk zone. **A collision risk assessment is required.**	**Yes**
Black headed gull	BoCCI Red Listed & Irish Wildlife Act.	**All Seasons** Local Importance (Higher Value)	The potential for habitat loss, while minimal, 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 at PCH during VP surveys. Collision risk is unlikely to significantly impact this species.	**Yes**
Cormorant	BoCCI Amber List & Irish Wildlife Act.	**N/A**	This species was recorded on a single occasion between April 2017 and September 2019. A bird was recorded flying across the Wind Farm Site below PCH. There is no evidence to suggest that this species utilises the local area during either the winter or breeding season. No flights were recorded within the potential collision risk zone.	**No**

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rational for inclusion/exclusion as KOR	KOR Yes/No
			There is no potential for habitat loss or displacement.	
Woodcock	BoCCI Red List (breeding) & Irish Wildlife Act.	**N/A**	This species was recorded on a single occasion, c. 730m from the Wind Farm Site. Numbers of ecological significance as per NRA criteria were not recorded. No evidence of breeding or foraging was recorded within the study area. No flights were recorded within the potential collision risk zone. No pathways for significant direct or indirect effects were identified.	**No**
Tufted Duck	BoCCI Red List & Irish Wildlife Act.	**N/A**	This species was recorded on a single occasion between April 2017 and September 2019. A small flock was recorded c. 2.5km east of the Wind Farm Site on Doo Lough. There is no evidence to suggest that this species utilises the local area during either the winter or breeding season. There is no potential for habitat loss or displacement. No pathways for significant direct or indirect effects were identified.	**No**
Buzzard	BoCCI Green List & Irish Wildlife Act.	**All Seasons** Local Importance (Higher Value)	The potential for habitat loss, while minimal, 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.	**All Seasons** Local Importance (Higher Value)	The potential for habitat loss, while minimal, 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.**	**Yes**

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rational for inclusion/exclusion as KOR	KOR Yes/No
			This species was recorded flying over the site within the potential collision risk zone. **A collision risk assessment is required.**	
Kestrel	BoCCI Amber List & Irish Wildlife Act.	**All Seasons** Local Importance (Higher Value)	The potential for habitat loss, while minimal, 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**
Snipe	BoCCI Amber List (breeding and winter) & Irish Wildlife Act.	**All Seasons** Local Importance (Higher Value)	The potential for habitat loss, while minimal, 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**
Passerines	BoCCI Red List & Irish Wildlife Act.	**N/A**	Significant effects are not anticipated given the nature of the habitats within the development footprint and the assemblage of bird species recorded. As per SNH guidance, it is generally considered that passerine species are not significantly impacted by wind farms.	**No**

8.7 KOR Sensitivity Determination

Criteria developed by Percival (2003) is presented in Table 8-3 (Section 8.2.5.3) for assessing bird sensitivity within the study area. There were no **Very High** sensitivity KORs as there were no bird populations recorded which were likely to be associated with SPA populations.

High Sensitivity KORs include:

- Hen Harrier (Ecologically sensitive species)

Medium Sensitivity KORs include:

- Golden Plover (Annex I; EU Birds Directive)
- Peregrine Falcon (Annex I; EU Birds Directive)
- Merlin (Annex I; EU Birds Directive)
- Common Tern (Annex I; EU Birds Directive)
- Herring Gull (Red-listed; BoCCI)
- Black-headed Gull (Red-listed; BoCCI)

The remaining KORs identified in the study area were classified as **Low Sensitivity**:

- Buzzard
- Sparrowhawk
- Kestrel
- Snipe

8.8 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 sites designated for nature conservation.
- Assessment of effects in relation to Key Ornithological Receptors
- Summary of potential effects associated with the proposed development

All elements of the Proposed Development have been considered in assessing effects on ecological receptors, including:

- Construction of up to 10 No. wind turbines with a maximum overall blade tip height of up to 170 metres and associated hard stand areas;
- 1 no. permanent Meteorological Mast with a maximum height of up to 100 metres;
- 1no. 38kV permanent electrical substation which will be constructed at one of two possible locations on site: either Option A in Carrownagry South townland or Option B in Cahermurphy townland. The electrical substation will have 1 no. control building with welfare facilities, all associated electrical plant and equipment, security fencing, all associated underground cabling, waste water holding tank and all ancillary works;
- All associated underground electrical and communications cabling connecting the turbines to the proposed on-site substation;
- All works associated with the connection of the proposed wind farm to the national electricity grid via an underground cable to the existing Booltiagh 110kV substation;
- Upgrade of existing tracks, roads and provision of new site access roads and hardstand areas;
- Junction access road works;

- 2 no. borrow pits;
- 1 no. temporary construction compound;
- Site Drainage;
- Forestry Felling to facilitate construction and operation of the proposed development; and
- All associated and ancillary site development works.

The full detailed description of the development is included in Chapter 4 of the EIAR.

8.8.1 Do-Nothing Effect

The land that forms the study area is dominated by conifer plantation, with small areas in the surrounding landscape of wet grassland, heath and degraded peatland.

If the proposed development for which this EIAR has been prepared does not go ahead, the site would continue to be managed for the existing commercial forestry. The biodiversity on the site would likely remain similar to its current state as activity levels and land use would not change significantly

8.8.2 Effects on Designated Areas

The Proposed Development is not located within the boundaries of any European or Nationally designated sites important for nature conservation (Figure 8.9). There will be no direct effects on any designated site as a result of the construction, operation and decommissioning of the Proposed Development.

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 with regard to Special Protection Areas. A summary of key assessment findings with regard to Special Areas of Conservation is provided in Chapter 7.

The Article 6(3) Appropriate Assessment Screening report identified the potential for the proposed development to result in significant effects due to deterioration of water quality on the following European Sites:

- ***Mid-Clare Coast SPA (004182)***

As a result, an Appropriate Assessment of the proposed development is required, and a Natura Impact Statement has been prepared in respect of the proposed development. The Natura Impact Statement concludes as follows:

> *"Where the potential for any adverse effect on any European Site has been identified, the pathway by which any such effect may occur has been robustly blocked through the use of avoidance, appropriate design and mitigation measures as set out within this report and its*

appendices. The measures ensure that the construction and operation of the Proposed Development does not adversely affect the integrity of European sites

Therefore, 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."

8.8.3 Effects Associated with the Grid Connection Route

There are 2 No. substations options; however, only one substation will ultimately be constructed and is being applied for as part of this application. Connection via the Booltiagh route would comprise underground cabling, measuring approximately 12.1 km in total, located on existing forestry and agricultural land and within the public road corridor.

The exact final detail and specifications of the grid connection route for the Proposed Development in accordance with the parameters described and assessed in this EIAR, will ultimately be confirmed by ESB/EirGrid.

Hen harrier

As previously discussed, the Doo Lough hen harrier territory recorded during 2019 and 2018 surveys is over 3.6km from the Wind Farm Site but is crossed by the Grid Connection Route. See Figure 1-1 in Confidential Appendix 8.7 for nest locations and associated activity. If construction works to facilitate the laying of the grid connection cable is undertaken during the hen harrier breeding season (1st of March to August 31st inclusive) there is potential for significant habitat loss and displacement impacts to result for this pair.

As per Percival (2003) the magnitude of the effect on hen harrier is assessed as Medium, given the habitats within this area (e.g. young forestry) are not scarce locally. The cross tablature of a High sensitivity species and Medium Impact corresponds to a High effect significance. The significance of the potential impact is classed as a short-term moderate negative effect following EPA criteria (2017). These potential impacts have been identified for mitigation.

All other KORs

The majority of habitats along the Grid Connection Route are of low ecological value (i.e. existing roads/tracks, agricultural land and forestry) and do not have potential to support species of conservation interest in the area. On a precautionary basis it is assumed that some temporary displacement may occur during construction works. However, given the extent of suitable habitat in the wider area; significant displacement effects are not predicted. The grid connection does not have the potential to result in any significant habitat loss or displacement of any other KOR species.

As per Percival (2003) the magnitude of the effect on KOR is assessed as Negligible. The cross tablature of a Medium sensitivity species and Negligible Impact corresponds to a Very Low effect significance. The significance of the potential impact is classed as a short-term slight negative effect following EPA criteria (2017).

No operational or decommissioning phase impacts are predicted.

8.8.4 Effects of Habitat Enhancement Area on Key Ornithological Receptors

The proposed enhancement area is specifically designed for the provision of biodiversity gain in the form of enhancement of peatland habitats, which will provide additional habitat for bird species

including hen harrier. The works involve the felling of commercial forestry and the blocking of drains throughout the area to encourage peatland restoration. All felling works will be undertaken in full accordance with the Coillte standard operating procedures and forest guidelines. Full details of proposed measures are provided in Appendix 8-8. It is concluded that the proposed works are of a nature and scale that there is no potential for them to result in any significant effect on any bird species.

8.8.5 Effects on Key Ornithological Receptors during Construction and Operation

8.8.5.1 Hen Harrier

Table 8-14 Impact Characterisation for Ecological 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)
Construction Phase			
Direct Habitat Loss	The Wind Farm Site is predominantly a large conifer plantation, that is flanked to the east and west by degraded peatland and wet/acid grassland. No breeding or roosting sites were recorded within the Wind Farm Site between April 2017 and September 2019. Hen harrier were recorded foraging within the Wind Farm Site. The majority of foraging flights were recorded in open habitats, as opposed to areas of forestry as per Figure 1.1 Appendix 8-7. The felling of forestry associated with the construction of the development has the potential to create new areas of potential foraging habitat. The amount of open habitat (e.g. peatland/wet grassland) that will be lost to the development footprint will be insignificant, relative to the availability of this habitat in the wider surroundings. Impacts related to the grid connection route have previously been discussed in Section 8.8.3.	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	The Doo Lough hen harrier territory recorded during 2018 surveys is over 3.6km from the Wind Farm Site. On the basis of this separation distance no potential impact is predicted for nesting attempts in this area. Impacts resulting from the grid connection route have previously been discussed in Section 8.8.3.	The magnitude of the effect is assessed as *low*. The cross tablature of a *High* sensitivity species and *Low*	**Short-term Slight Negative Effect**

	No roosting was recorded within the Wind Farm Site between April 2017 and September 2019. In total, three winter roosts were recorded within 500m of the development boundary. One roost was recorded in 2017/18 and two in the following winter (2018/19). On subsequent survey visits to these locations no roosting hen harrier were recorded. These roosts are therefore not considered to have been in regular use. Hen harrier were recorded foraging within the Wind Farm Site. It is unlikely that any significant displacement impact resulting from construction will occur, given the availability of large areas of similar suitable roosting habitat in the wider surroundings.	Impact corresponds to a ***Low*** effect significance	
Operational Phase			
Direct Habitat Loss	Direct effects are not anticipated	**No Effect**	**No Effect**
Displacement	No breeding hen harrier were recorded within the Wind Farm Site during the survey period between April 2017 to September 2019. There is no potential for disturbance or displacement of the nest site that was recorded c. 3.6km to the east as a result of the Wind Farm Site. Hen harrier were recorded roosting within 500 metres of the Wind Farm Site on only three occasions during the surveys undertaken. These roost sites were not regularly used by the birds and significant disturbance or displacement is not predicted. No roosting behaviour was recorded within the windfarm site boundary. Hen harrier were regularly recorded foraging within the windfarm site. The majority of the flights were recorded during the breeding season and were located in the open areas of the site (See Figure 1.1 Appendix 8-7) Most of the foraging activity is over the eastern section of the site and is up to 5km from the recorded nest site near Doo Lough (see confidential Appendix 8-7).	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 Moderate Negative Effect**

	Research carried out by University College Cork (Wilson et al. 2015), noted hen harrier foraging to a distance of 5km from nest sites. It is therefore likely that the Wind Farm Site is at the very edge of the foraging range of the recorded nest site. Hen harrier show small scale avoidance of operational turbines resulting in a relatively small loss of potential foraging habitat (Haworth and Fielding, 2012). In the worst-case scenario, it can be assumed that all lands within 250m of operational turbines are unavailable to foraging hen harrier (Pearce-Higgins et. al., 2009). It is also noted that areas of closed canopy forestry surrounding the turbines are not currently available to foraging hen harrier. The amount of foraging habitat that will be unavailable to hen harrier during the lifetime of the windfarm (taking into account the Coillte commercial felling and reforestation plans for the site) has been calculated and these calculations are provided in Appendix 8.8. The quantum of foraging habitat that will become unavailable to foraging hen harrier during the lifetime of the wind farm is estimated to be 63 hectares. This follows an extremely precautionary approach, which assumes that there will be no hen harrier flights within 250metres of an operational turbine. The potential area of avoidance (i.e. 63ha) is considered a low to moderate loss/avoidance of suitable habitat at the local level. Therefore, taking into consideration this predicted impact and the significance of the study area to foraging hen harrier; a hen harrier and peatland habitat enhancement plan has been devised with the aim of creating suitable foraging and breeding habitat for the species within the North and West Clare area.		

Collision	The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk has been undertaken and full details are provided in Appendix 8-6. The collision risk has been calculated at a ratio of 0.004 collisions per year. This equates to less than one bird (0.12) during the 30-year lifespan of the wind farm. 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 Effect**

8.8.5.2 Golden Plover (*Wintering*)

Table 8-15 Impact Characterisation for Ecological 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)
Construction Phase			
Direct Habitat Loss	This species was not recorded utilising habitats within the Wind Farm Site for roosting or foraging. Golden plover was recorded flying across the site on two occasions. No evidence of foraging activity was recorded at this location. The majority of the development footprint is dominated by conifer plantation, which does not provide suitable habitat for the species. Significant effects with regard to direct habitat loss 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	**Long-term Slight Negative Effect**
Displacement	No roosting sites were recorded within the study area and there is no evidence to suggest the windfarm site is of significance to wintering populations. Disturbance during construction is unlikely to discourage flight activity or foraging in the vicinity of the Wind Farm Site 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*	**Short-term Slight Negative Effect**

	Significant displacement effects are not anticipated.	Impact corresponds to a ***Low*** effect significance	
Operational Phase			
Direct Habitat Loss	Direct effects are not anticipated	**No Effect**	**No Effect**
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 175m 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, outside any potential displacement buffer, 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 *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 has been undertaken and full details are provided in Appendix 8-6. The collision risk assessment has followed a precautionary approach and utilises flight observations recorded across all seasons. Therefore, the assessment provided below is highly conservative. The collision risk has been calculated at a rate of 0.38 collisions per year. Annual mortality of adult golden plover has been calculated at 27% per annum (Sandercock, 2003). If 0.38 collisions were to occur per year, it would mean	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**

	that the losses at the Wind Farm Site would increase the annual background mortality of the county population (i.e. 3,161) by 0.1%. The predicted collision risk is therefore negligible in the context of the county, national and international population.		

8.8.5.3 Merlin (All Seasons)

Table 8-16 Impact Characterisation for Ecological 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)
Construction Phase			
Direct Habitat Loss	This species was not recorded utilising habitat within the site boundary for roosting or breeding. Merlin were recorded within the Wind Farm Site on a single occasion. Extensive areas of suitable foraging 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 *negligible*. The cross tablature of *Medium* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**
Displacement	No breeding or roosting sites were recorded within the study area. In total, merlin were recorded on two occasion onsite/within 500m of the Wind Farm Site . Significant displacement effects are not anticipated, given how infrequently this species was encountered and owing to	The magnitude of the effect is assessed as *negligible*. The cross tablature of *Medium* sensitivity	**Short-term Slight Negative Effect**

	the abundance of similar suitable foraging habitat in the wider surroundings of the Wind Farm Site .	species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	
Operational Phase			
Direct Habitat Loss	Direct effects are not anticipated	**No Effect**	**No Effect**
Displacement	The low levels of activity recorded limit the potential for ecologically significant effect to result. Furthermore, extensive areas of suitable foraging habitat will remain post construction and there is an abundance of suitable habitat in the surrounding area, such that any potential displacement effect is rendered inconsequential.	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	None of the flights recorded during VP surveys were at potential collision height. Collision risk is not likely to significantly impact this species.	**No Effect**	**No Effect**

8.8.5.4 Peregrine Falcon

Table 8-17 Impact Characterisation for Ecological 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)
Construction Phase			
Direct Habitat Loss	This species is unlikely to be dependent on the onsite habitats, given that the internal infrastructure constitutes a small proportion of the total Wind Farm Site, the wide-ranging nature of the species and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ coniferous plantation). Significant impacts are not predicted.	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**
Displacement	There were four observations of this species throughout the entire survey period: April 2017 to September 2019. Significant displacement effects are not anticipated, given how infrequently this species was encountered and owing to the abundance of similar suitable foraging habitat in the wider surroundings of the Wind Farm Site.	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.	**Short-term Slight Negative Effect**
Operational Phase			
Direct Habitat Loss	Direct effects are not anticipated	**No Effect**	**No Effect**
Displacement	In total, this species was recorded on four occasions between April 2017 and September 2019. The availability of alternative suitable habitat in the	The magnitude of the effect is assessed as *Negligible*.	**Long-term Slight Negative Effect**

	surroundings and the overall infrequency of occurrence of the species at the site, limit the potential for significant disturbance displacement effects. Significant displacement effects are not predicted.	The cross tablature of a *Medium* Sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance.	
Collision	The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk has been undertaken and full details are provided in Appendix 8-6. The collision risk has been calculated at a ratio of 0.001 collisions per year. This equates to less than one bird (0.04) during the 30-year lifespan of the wind farm. 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 *Medium* Sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance.	**Long-term Imperceptible Effect**

8.8.5.5 Common Tern

Table 8-18 Impact Characterisation for Ecological 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)
Construction Phase			
Direct Habitat Loss	The Wind Farm Site does not contain suitable foraging, roosting or breeding habitat for this wetland species.	**No Effect**	**No Effect**
Displacement	This species was recorded on a single occasion between April 2017 and September 2019. No regular commuting corridor was identified. No pathway to a significant effect was identified.	**No Effect**	**No Effect**

Operational Phase			
Direct Habitat Loss	Direct effects are not anticipated	**No Effect**	**No Effect**
Displacement	This species was recorded on a single occasion between April 2017 and September 2019. Alterations to onsite habitat post construction are not predicted to attract this species to the site with increased regularity. No pathway to a significant effect was identified.	**No Effect**	**No Effect**
Collision	The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk has been undertaken and full details are provided in Appendix 8-6. The collision risk has been calculated at a ratio of 0.002 collisions per year. This equates to less than one bird (0.07) during the 30-year lifespan of the wind farm. 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 *Medium* Sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance.	**Long-term Imperceptible Effect**

8.8.5.6 Herring Gull

Table 8-19 Impact Characterisation for Ecological 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)
Construction Phase			
Direct Habitat Loss	The Wind Farm Site does not contain suitable roosting or breeding habitat for this species. This species has been recorded foraging onsite. However, only a small proportion of the total Wind Farm Site contains suitable foraging habitat for herring gull. This species will on occasion forage in terrestrial habitats, e.g.	The magnitude of the effect is assessed as *low*.	**Long-term Slight Negative Effect**

	agricultural grassland. The habitat that will be lost to the development footprint will be minimal and large areas of suitable foraging habitat will remain post construction.	The cross tablature of a *Medium* Sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance.	
Displacement	Herring gull were recorded foraging onsite, however this foraging activity was restricted to the areas of open habitat fringing the Wind Farm Site. The large areas of similar suitable habitat in the wider surroundings limits the potential for ecologically significant effects to result from the Wind Farm Site. Therefore, should a displacement impact result it is considered to be rendered inconsequential. 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 effects are not anticipated	**No Effect**	**No Effect**
Displacement & Barrier Effect	Significant displacement impacts are not predicted given this is a wide-ranging species and there is an abundance of similar suitable habitat in the wider surroundings of the Wind Farm Site. This species was regularly recorded flying across the Wind Farm Site. Were a barrier effect to occur the additional energy expenditure involved in birds diverting around the wind farm are not considered significant in the context of the overall distances foraging herring gull regularly travel. Herring gulls can range to c.26km from coastal colonies (Enners et al., 2018). Significant barrier 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 has been undertaken and full details are provided in Appendix 8-6.	On a highly precautionary basis, the magnitude of the effect is assessed as *low*.	**Long-term Slight Negative Effect**

	The collision risk has been calculated at a rate of 2.78 collisions per year. A review of the Bird Atlas (2007-11) revealed numerous instances of confirmed breeding along the Clare coastline, despite this, information on the county population of breeding herring gull was not readily available. The predicted rate of collisions is judged to be insignificant for the local population. Article 12 of the Birds Directive (Directive 2009/147/EC) reports the national population of breeding herring gull to be c.4,600 birds. The predicted rate of collisions are considered insignificant at a national and international level.	The cross tablature of a *Medium* Sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance.	

8.8.5.7 Black-headed Gull

Table 8-20 Impact Characterisation for Ecological 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)
Construction Phase			
Direct Habitat Loss	This species was only recorded on four occasions at the Wind Farm Site in September 2019. This low level of recorded activity limits the potential for ecologically significant impacts to result from the proposed development. Direct loss of potential foraging habitat to the footprint of the development will be minimal. Significant impacts 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**
Displacement	The Wind Farm Site 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.	The magnitude of the effect is assessed as *low*.	**Short-term Slight Negative Effect**

	Significant displacement effects are not anticipated.	The cross tablature of a *Medium* Sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance.	
Operational Phase			
Direct Habitat Loss	Direct effects are not anticipated	**No Effect**	**No Effect**
Displacement	Large section of the Wind Farm Site is dominated by conifer plantation, a habitat type that is not favoured by this species. Suitable foraging habitat is restricted to open areas in the margins of the Wind Farm Site. Were displacement to occur it is likely to be inconsequential given the availability of large areas of potential foraging habitat (e.g. grassland) in the wider surroundings.	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	None of the flights recorded during VP surveys were at potential collision height. Collision risk is not likely to significantly impact this species.	**No Effect**	**No Effect**

8.8.5.8 Buzzard (*All Seasons*)

Table 8-21 Impact Characterisation for Ecological 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)
Construction Phase			
Direct Habitat Loss	The felling of forestry may temporarily reduce the availability of trees of sufficient stature to provide potential nest sites. However, significant areas of suitable nesting and foraging habitat will continue to exist within the development site. Substantial areas of undisturbed suitable foraging habitat will remain outside the development footprint.	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	Construction in forestry areas could potentially cause displacement of breeding buzzard. However, given the availability of potential alternative nesting sites 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 *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 effects are not anticipated	**No Effect**	**No Effect**
Displacement	Onsite habitats are not considered unique to the Wind Farm Site. Pearce Higgins (2009) describes that buzzard has been found to show significant turbine avoidance extending to at least 500m. Despite this, significant effects	The magnitude of the effect is assessed as *low*.	**Long-term Slight Negative Effect**

	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). Significant displacement effects are not anticipated.	The cross tablature of *Low* sensitivity species and *Low* Impact corresponds to a ***Very Low*** effect significance	
Collision	The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk has been undertaken and full details are provided in Appendix 8-6. The collision risk has been calculated at a ratio of 0.145 collisions per year. This equates to 4.34 birds during the 30-year lifespan of the wind farm. 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 Slight Negative Effect**

8.8.5.9 Sparrowhawk (*All Seasons*)

Table 8-22 Impact Characterisation for Ecological 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)
Construction Phase			
Direct Habitat Loss	The felling of forestry may temporarily reduce the availability of trees of sufficient stature to provide potential nest sites. However, significant areas of suitable breeding and foraging habitat will remain. Significant impacts are not predicted.	The magnitude of the effect is assessed as *low* The cross tablature of a *Low* sensitivity species and a *Low* Impact corresponds to a ***Very Low*** effect significance.	**Long-term Slight Negative Effect**

Displacement	Construction in forestry areas 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 widespread breeding distribution of this species limits the potential for ecologically significant effects. Significant displacement effects are not anticipated.	The magnitude of the effect is assessed as *low* The cross tablature of a *Low* sensitivity species and a *Low* Impact corresponds to a ***Very Low*** effect significance.	**Short-term Slight Negative Effect**
Operational Phase			
Direct Habitat Loss	Direct effects are not anticipated	**No Effect**	**No Effect**
Displacement	The Wind Farm Site 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 a *Low* sensitivity species and a *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 has been undertaken and full details are provided in Appendix 8-6. The collision risk has been calculated at a ratio of 0.015 collisions per year. This equates to less than one bird (0.46) during the 30-year lifespan of the wind farm. 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 Effect**

8.8.5.10 Kestrel (*All Seasons*)

Table 8-23 Impact Characterisation for Ecological 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)
Construction Phase			
Direct Habitat Loss	The Wind Farm Site contains conifer plantation, with small areas of degraded peatland, heath and wet grassland. Direct loss of breeding and foraging habitat relative to its availability onsite, will be minimal. Substantial areas of undisturbed suitable breeding and foraging habitat will remain. Significant impacts are not predicted.	The magnitude of the effect is assessed as *low* The cross tablature of a *Low* sensitivity species and a *Low* Impact corresponds to a ***Very Low*** effect significance.	**Long-term Slight Negative Effect**
Displacement	The Wind Farm Site 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 kestrel population. A probable nest site was located c. 450m to the east of the Wind Farm Site and in excess of 1.1km from the nearest turbine. The separation distance between this nest site and the Wind Farm Site limits the potential for disturbance to result during construction works. Significant displacement effects are not anticipated.	The magnitude of the effect is assessed as *low* The cross tablature of a *Low* sensitivity species and a *Low* Impact corresponds to a ***Very Low*** effect significance.	**Short-term Slight Negative Effect**
Operational Phase			
Direct Habitat Loss	Direct effects are not anticipated	**No Effect**	**No Effect**

Displacement	A probable nest site was located 1.1km from the nearest turbine. Displacement impacts at this nest are not predicted based on the substantial separation distance involved. 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 habitats exist and will remain in the wider area. Onsite habitats are not considered unique to the Wind Farm Site.	The magnitude of the effect is assessed as *low* The cross tablature of a *Low* sensitivity species and a *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 has been undertaken and full details are provided in Appendix 8-5. The collision risk has been calculated at a ratio of 0.31 collisions per year. This equates to 9.31 birds during the 30-year lifespan of the wind farm. 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 Slight Negative Effect**

8.8.5.11 Snipe (*All Seasons*)

Table 8-24 Impact Characterisation for Ecological 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)
Construction Phase			
Direct Habitat Loss	Land taken during the construction phase of the development will be discernible, however substantial areas of undisturbed suitable breeding and foraging habitat will remain. Snipe favour open habitats for foraging and breeding. Therefore, direct loss of breeding and foraging habitat will be	The magnitude of the effect is assessed as *low* The cross tablature of a *Low* sensitivity species and a *Low*	**Long-term Slight Negative Effect**

	minimal, given the majority of the proposed infrastructure will be sited in forestry. Significant impacts are not predicted.	Impact corresponds to a ***Very Low*** effect significance.	
Displacement	As previously stated, snipe favour open habitats for foraging and breeding. Therefore, loss of breeding and foraging habitat will be minimal, given the majority of the proposed infrastructure will be sited in forestry. Should any potential displacement effect occur, there are extensive areas of suitable habitat in the wider area, to render this potential impact inconsequential.	The magnitude of the effect is assessed as *low* The cross tablature of a *Low* sensitivity species and a *Low* Impact corresponds to a ***Very Low*** effect significance.	**Short-term Slight Negative Effect**
Operational Phase			
Direct Habitat Loss	Direct effects are not anticipated	**No Effect**	**No Effect**
Displacement	Significant effects are not anticipated. Extensive areas of suitable breeding and foraging habitat will remain post construction. Pearce Higgins et.al (2009), found that breeding snipe showed significant avoidance of turbines extending to a distance of 400m. However, given the availability of potential alternative breeding and foraging habitat in the wider area, significant effects are not anticipated.	The magnitude of the effect is assessed as *low* The cross tablature of a *Low* sensitivity species and a *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 largely 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 species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk has been undertaken and full details are provided in Appendix 8-6.	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**

	The collision risk has been calculated at a ratio of 0.015 collisions per year. This equates to less than one bird (0.46) during the 30-year lifespan of the wind farm. The predicted collision risk is insignificant in the context of the county, national and international population.		

8.8.6 Effects on Key Ornithological Receptors during Decommissioning

8.8.6.1 All Species

Table 8-25 Impact Characterisation for Ecological 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)
Construction 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

8.9 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.

8.9.1 Mitigation by Design

The project design has followed the basic principles outlined below to eliminate the potential for significant effects on avian receptors:

- Hard standing areas have been designed to the minimum size necessary to accommodate the selected turbine model.
- The grid connection route and internal roads has been selected to utilise built infrastructure for the majority of its length (i.e. cables to be laid within existing forestry and public roads). Cables will be laid underground to avoid (potential) bird collisions associated with overhead power lines.

8.9.2 Mitigation During Construction, Operation and Decommissioning

The following section describe the mitigation measures to be implemented during each phase of the Proposed Development.

8.9.2.1 Construction Phase Mitigation

The following measures are proposed for the construction phase:

- 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.
- Taking a precautionary approach, it is proposed that construction works will commence outside the bird nesting season (1st of March to 31st of August inclusive).
- In addition, to avoid impacting breeding hen harrier along the grid connection route no construction works shall be undertaken within a 500m buffer (Forestry Commission Scotland 2006; Ruddock & Whitfield 2007) of the Doo Lough hen harrier territory. See Figure 1-1 in Confidential Appendix 8.7 for territory location. No works shall be permitted within the buffer between the 1st of March and the 31st of August or until it can be demonstrated that the nest is no longer occupied.
- The removal of woody vegetation will be undertaken in full compliance with Section 40 of the Wildlife Act 1976 – 2018. Where sections of woody vegetation are removed for the purposes of the junction and road upgrades, these will be replaced with suitable hedge/tree species which are common in the local context.
- 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 machinery will be turned off when not in use.

- All plant and equipment for use will comply with the Construction Plant and Equipment Permissible Noise Levels Regulations 1996 (SI 359/1996) and other relevant legislation.
- An Ecological Clerk of Works (ECoW) will be appointed. Duties will include:
    - Undertake a pre-construction transect/walkover bird survey to ensure that previously unrecorded breeding bird sites will be avoided. Further details provided in Section 8.11.1 below.
    - 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.

8.9.2.2 Operational Phase Mitigation

No operational phase impacts requiring mitigation were identified.

8.9.2.3 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 e.g. commencing works outside the bird nesting season (1st of March to 31st of August inclusive).
- Plant machinery will be turned off when not in use.
- All plant and equipment for use will comply with the Construction Plant and Equipment Permissible Noise Levels Regulations (SI 359/1996).

8.10 Hen Harrier and Peatland Habitat Enhancement Plan

In acknowledgement of the moderate displacement impact identified in Section 8.8.3 and the significance of the study area to hen harrier a foraging habitat enhancement plan has been prepared (See Appendix 8.8). The plan also ensures that no potential for significant displacement effect within the North and West Clare non-designated hen harrier area occurs as a result of the proposed development. The plan has given consideration to the approaches previously proposed on other proposed wind farm developments with input from the Department of Arts, Heritage and the Gaeltacht (National Parks and Wildlife Service), which were subsequently approved by their respective Planning Authorities.

The plan has been prepared taking account of the detailed forestry management plans already in place for the on-site and adjacent commercial forestry plantation owned and managed by Coillte. The plan objective is to pre-maturely fell an area of forestry which would otherwise be sub-optimal hen harrier habitat. The proposed enhancement area is approximately 28.2ha. This newly created open habitat would be maintained as such for the duration of the operational phase of the wind farm. The area chosen is located within the North and West Clare non-designated area for hen harrier and is connected to extensive areas of suitable foraging habitat in the wider area (i.e. Cragnashingaun Bogs NHA). The aim in abutting the proposed enhancement area and the Cragnashingaun Bogs NHA is to increase the amount of contiguous open habitat available to hen harrier locally. Further location details are provided in Appendix 8.8.

Management prescriptions to be implemented by the applicant include:

- Pre-mature felling of forestry before the first breeding season of the construction phase of the project programme. This would allow time for the clear-felled site to revegetation in advance of the operational phase. Thereby ensuring replacement habitat would be available should the predicted displacement effect occur.
- Habitat enhancement: drain blocking and measures to encourage the recolonization of the land with native vegetation, e.g. scarifying the area to encourage the growth of seedlings.
- Habitat maintenance: removal of self-sown conifer seedlings from adjacent forestry
- Monitoring

In addition to the enhancement plan it is proposed to engage local landowners in a programme to farm in a hen harrier friendly manner (See Appendix 8.8). The programme will broadly follow the approach taken by the Hen Harrier Project (www.henharrierproject.ie). The aim of the programme will be to safeguard existing hen harrier habitat and promote the creation of new supporting habitat for hen harrier and their prey. The farmland proposed for inclusion in the programme covers an area of approximately 30ha. The location of this proposed land is provided in Appendix 8.8. The applicant would engage local landowners to participate in the programme in advance of the first breeding season of the operational phase of the project programme. Thereby ensuring management measures are in place should the predicted displacement of foraging hen harrier from the development footprint occur.

Management prescriptions to be implemented by the programme participants include:

- Establishing linear strips of wildlife cover to increase the availability of foraging habitat for hen harrier locally. This measure will involve the sowing/planting of a wildlife seed crop and/or native hedgerows. Hedgerow species must be suitable for the conditions (soil and location).
- Low intensity grazing, to ensure cover for prey species is present.
- Management of rushes (Juncus spp) to promote a diverse sward in rough and wet grassland.
- Cutting rides through large block of existing scrub, creates more edges and a linear feature for hen harrier to hunt along.
- Safeguarding existing heather and scrub. The selected areas should be on a slope, at least 250m from forestry and contain heather/scrub. The aim is to promote vegetation succession towards tall heather/scrub to provide nesting habitat for hen harrier and their prey. The area should be fenced off to control grazing.

Site Selection

The enhancement area and the hen harrier programme lands are located in close proximity to the nest site to the south of Doo Lough. Increasing the productivity of the habitat adjacent to the nest site should increase breeding success, i.e. by decreasing the energy expenditure involved in foraging this will allow the parents to provision the nest more frequently and increase the likelihood that adults are present to defence the nest during a potential predation event.

Conclusions

With the successful implementation of the enhancement plan and hen harrier programme the proposed development will result in a net gain for hen harrier locally.

8.11 Monitoring

8.11.1 Commencement and Pre-Construction Monitoring (Hen Harrier)

Taking a precautionary approach, it is proposed that construction works will commence outside the bird nesting season (1st of March to 31st of August inclusive). Pre-commencement surveys will be undertaken prior to the initiation of works at the wind farm.

A breeding bird survey will be undertaken between April and July. Monitoring will be undertaken by a suitably qualified ornithologist. The survey will include a thorough walkover survey to a 500m radius of the development footprint and/or all works areas, where access allows. If breeding activity of birds of high conservation concern is identified, the nest site will be located, and earmarked for monitoring at the beginning of the first breeding season of the construction phase. If it is found to be active during the construction phase no works shall be undertaken within a 500m buffer (Forestry Commission Scotland 2006; Ruddock & Whitfield 2007) in line with best practise. No works shall be permitted within the buffer until it can be demonstrated that the nest is no longer occupied.

8.11.2 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 8-9. 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 & 15 of the life-time 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:

- Vantage Point Surveys
- Breeding Bird Surveys (particularly focused on hen harrier).
- Hen Harrier Roost Surveys
- Targeted bird collision surveys (corpse searches). The corpse searches will include detection and scavenger trials.

The area proposed for enhancement and the hen harrier programme will be the subject of ongoing monitoring during the operational phase of the wind farm to ensure they are offering hen harrier supporting habitat. The ongoing monitoring will take place primarily during the summer breeding bird season when hen harrier activity is likely to be greatest, and foraging areas most in use. The monitoring will seek to identify whether hen harriers are actually foraging over the areas under active management and will be conducted by way of fixed-point vantage point surveys.

8.12 Residual Effects

The following species were identified as KORs and were subject to detailed impact assessment:

- Golden Plover
- Hen Harrier
- Merlin
- Peregrine Falcon
- Common Tern
- Herring Gull
- Black-headed Gull
- Buzzard
- Sparrowhawk

- Kestrel
- Snipe

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*** 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, with the exception of hen harrier.

Net Gain

With the successful implementation of the enhancement plan and hen harrier programme the proposed development will result in a net gain for hen harrier locally.

8.13 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)

8.13.1 Other Projects

Assessment material for this in combination impact assessment was compiled on the relevant developments within the vicinity of the proposed project and was verified in March 2020. 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.

8.13.2 Projects Considered in the Cumulative Impact Assessment

A review of the Planning Register for Clare County Council shows that there has been a number of existing projects and 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 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 include the following:

- Permitted Glenmore Substation – Planning Ref. No. 14/614 (Under Construction) Clare Winds Ltd. applied to Clare County Council for a ten-year permission for the construction of a revised electricity substation already granted under Pl. Ref. 02/2228 (and as extended by Pl. Refs. 09/438 and 14/309.

- Permitted 110kV Booltiagh Substation Extension - Planning Ref. No. 14/761 (Under Construction) ESB applied to Clare County Council for planning permission development consisting of alterations and extension to the existing Booltiagh 110kV substation

- Permitted 38kV Overhead Line to 110kV Booltiagh Substation – Pl. Ref. No. 14/545 (Under Construction) ESB Wind Development Ltd. applied to Clare County Council for permission to construct a 7.1km 38 kV overhead line connecting the Boolynagleragh Wind Farm with the existing 110kV substation at Booltiagh. The overhead line structures comprise of wooden polesets with two end masts being steel structures. All structures range in height from 10m to 18m. Permission was granted subject to conditions by the Planning Authority on the 30th April 2015. The development is currently in construction.

- Permitted Quarry at Glenmore, Kilmihil, Co. Clare - Pl. Ref. No. 13/681 Western Excavations & Groundworks Ltd. applied to Clare County Council for permission to develop a quarry and all associated site development and infrastructure works services including site office, staff welfare facilities, site boundary treatment, landscaping and site reinstatement on a site measuring approximately 1 hectare in the townland of Glenmore. The application was granted permission subject to conditions by the Planning Authority on the 15th February 2018.

Forestry and Agricultural Practices

To the east, north-east and south-east the surrounding area is dominated by commercial forestry, with small areas managed for agriculture in the form of livestock grazing. To the west the landscape is dominated by intensively grazed agricultural grassland of low ecological value.

Other Wind Farm Developments

- Permitted Cahermurphy Wind Farm – Pl. Ref. 14/551 Mid-Clare Renewable Energy Limited granted permission for the construction of a 4 no. wind turbine development in Cahermurphy, Co. Clare. This application sought to replace the permitted 6 no. turbines previously granted under Pl. Ref. 03/2071 with 4 no. larger turbines with a maximum ground to blade tip height of up to 131m. Three of four turbines constructed and operational.

- Permitted amendment to Cahermurphy wind farm amending the height of turbine no. 3 from previously permitted 131m to 150m. Granted on 29th April 2019.

- Permitted Booltiagh Wind Farm – Pl. Ref. No. 00/567 Application by DP Energy Ltd. Under which permission was granted by An Bord Pleanála under PL.03.120616 for 15 no. turbines. The Board considered the number of turbines could be accommodated in the landscape without any significant impact on the landscape or amenities in the area. This wind farm is now operational.

- Permitted Extension to Booltiagh Wind Farm – Pl. Ref. No. 07/2900 Application by DP Energy Ltd. comprised of six wind turbines at Booltiagh. The application was granted permission by the Planning Authority. Currently operational.

- Permitted Letteragh Wind Farm – Pl. Ref. No. 11/361 (Operational) Application by Seahound Wind Energy Development Ltd. to Clare County Council for the construction of a 6 no. turbines with a maximum hub height of 90m and maximum blade diameter of 93m, meteorological mast, access and internal roads/tracks, electricity substation, cabling and all associated site works. The application was granted by the Board with conditions on the 21st February 2013 under PL03.239933.

- Permitted Boolynagleragh Wind Farm – Pl. Ref. No. 09/479 (Under Construction) 9 turbine wind farm with a tower up to 80 metres high with a blade length of 45 metres. The Board

granted permission for the development subject to conditions on the 7th December 2010 under PL03.236376. The wind farm is currently under construction.

- Permitted Boolynagleragh Wind Farm Extension – Pl. Ref. No. 13/681 (Operational) seven turbine project, with tip heights of 126 metres) extension to the existing Boolynagleragh Wind Farm. Permission granted by An Bord Pleanála on the 13th June 2016 under PL03.244095).

8.13.3 Assessment of Cumulative Effects

The following species were identified as KORs and were subject to detailed impact assessment: golden plover, hen harrier, merlin, peregrine falcon, common tern, herring gull, black-headed gull, buzzard, sparrowhawk, kestrel and snipe. Of these species, hen harrier was identified as the key species potentially vulnerable to cumulative impacts locally. Hen harrier were identified for cumulative assessment given the decline in the local breeding population and following a review of national pressures and threats acting on hen harrier, as reported (2008-2012) under Article 12 of the Birds Directive (Directive 2009/147/EC).

The hen harrier population found within the north and west Clare area has experienced a 50% decrease in occupancy between 2010 and 2015 (Ruddock et al., 2015). The decline in hen harrier populations in Ireland are as a result of human related pressures, in particular habitat modification and loss (Watson, 1977, O'Flynn, 1983, Amar & Redpath, 2005). The proposed development is located at the western edge of the North and West Clare non-designated regionally important area for hen harrier. The two industries which most closely overlap with this region are forestry and wind farm developments. Forestry in the landscape is considered a net negative for hen harrier. Only young forestry (less than ten years old) provides foraging and nesting opportunities, and nests in forestry can be subject to high levels of predation. Hen harrier show small scale avoidance of operational turbines resulting in a relatively small loss of potential foraging habitat (Haworth and Fielding, 2012). The combined habitat loss associated with forestry and wind farms has the potential to result in significant impacts for hen harrier locally. However, the proposed development will not contribute to this potential cumulative impact.

Hen Harrier Net Gain

The growth of the wind farm industry and the potential for large areas of the Irish uplands to support wind farm developments is likely to see a continued interaction between this industry and hen harrier. However, 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 proposed development is considered a sustainable development as following the implementation of the measures outlined in Section 8.10 a net gain is predicted for the local hen harrier population.

The proposed measures are based on industry best practices, as prescribed by the Hen Harrier Project (www.henharrierproject.ie), which provides confidence in their likely success. Therefore, the proposed development will not contribute to habitat loss, whether additive, antagonistic or synergistic.

Other Key Ornithological Receptors

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 in any of the assessments undertaken. Therefore, significant cumulative barrier effect is not anticipated.

No potentially significant cumulative disturbance, displacement or habitat loss 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.

8.14 Conclusion

No significant effects are predicted on birds due to direct habitat loss or displacement during the construction, operational phases of the Proposed Development. Collision risk calculations does not indicate that the development will have significant effects on any KOR recorded either in isolation or cumulatively with other wind farms.

Effects of decommissioning are predicted to be shorter and less obtrusive than effects arising from construction.

With the exception of hen harrier for which there will be a net gain, provided that the Proposed Development is constructed, operated and decommissioned in accordance with the design, best practice and mitigation that is described within this application, significant individual or cumulative effects on ornithology are not anticipated at the international, national or county scales or on any of the identified KORs.

9. LAND SOILS AND GEOLOGY

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 impacts of the proposed Cahermurphy Phase Two Windfarm Project (i.e. 10 no. turbines at the wind farm site, grid connection cable route, haul route works, replacement planting lands and hen harrier enhancement area) on the land, soil and geological environment. The Proposed Development site which includes the windfarm and the grid connection cable route is located near Creegh, Co. Clare.

This report provides a baseline assessment of the environmental setting of the Proposed Development site and the other Project elements in terms of land, soils and geology and discusses the likely significant direct, indirect and cumulative potential effects that the construction, operation and decommissioning of the proposed Project will have on them. Where required, appropriate mitigation measures to limit any identified significant effects to land, soils and geology (i.e. natural resources) are recommended and any residual effects are noted where applicable.

Please note that in this chapter we refer to the wind farm (WF) site, and the cable route, and the study area. These identifiers are shown on Plate 9-2. Other elements of the Project are referenced accordingly (i.e. replacement planting lands etc).

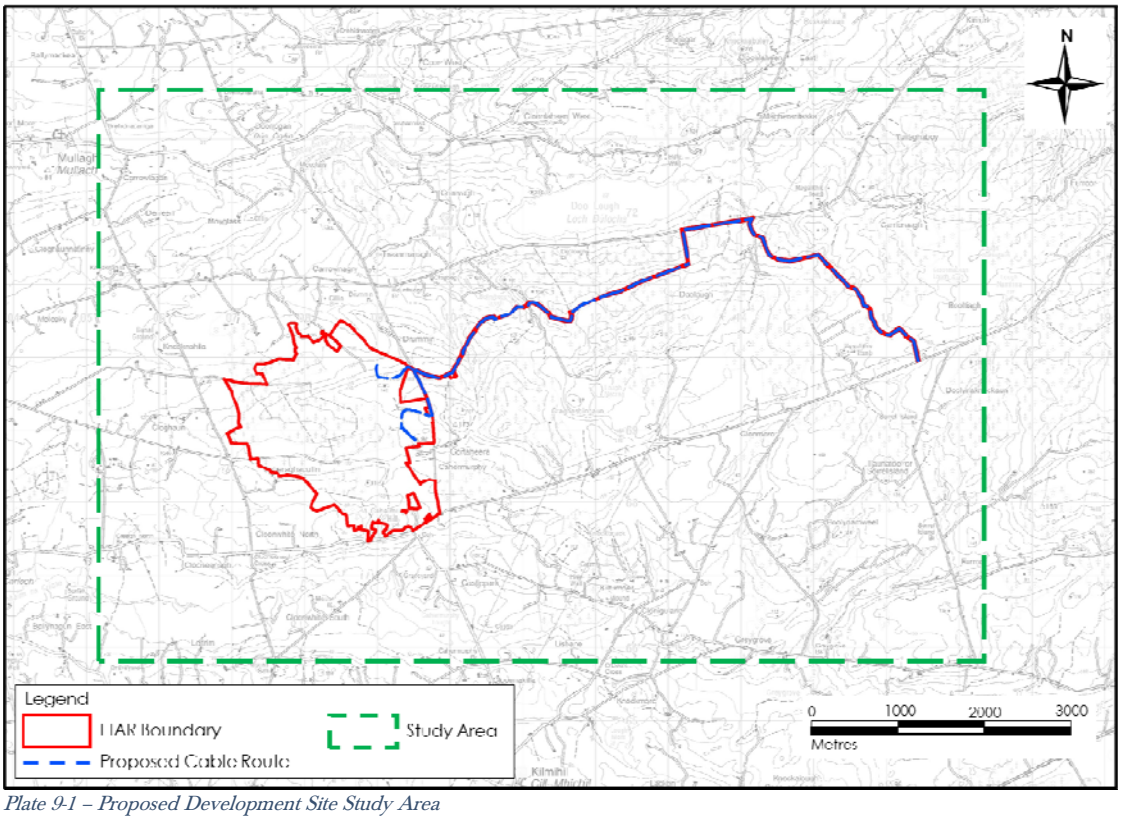


Plate 9-1 – Proposed Development Site Study Area

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 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.

This chapter of the EIAR was prepared by David Broderick and Michael Gill.

David Broderick (BSc, H. Dip Env Eng, MSc) is a hydrogeologist with over 13 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 geological assessments and 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 EIARs for a range of commercial developments. David has worked on the EIS/EIARs for Slievecallan WF, Cahermurphy (Phase I) WF, and Oweninny WF, and over 60 other wind farm related projects across the country.

Michael Gill (P. Geo., B.A.I., MSc, Dip. Geol., MIEI) is an Environmental Engineer and Hydrogeologist with over 18 years' environmental consultancy experience in Ireland. Michael has completed numerous geological, 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/EIARs for Slievecallan WF, Cahermurphy (Phase I) WF, and Carrownagowan WF, and over 100 other wind farm related projects across the country.

9.1.3 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; and,
- National Roads Authority (2005): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.

9.2 Schedule of Works

9.2.1 Desk Study

A desk study of the wind farm site, the cable route and overall Project 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 of the following:

- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 17 (Geology of Shannon Estuary), 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).

9.2.2 Baseline Monitoring and Site Investigations

Walkover surveys, site investigations and geological mapping was undertaken by HES on 11th September and 21st November 2019. Peat depth measurements and a geotechnical investigation was undertaken by Fehily Timoney and Company – FTC (formally called AGEC Ltd) in August and September 2019.

The objectives of the intrusive site investigations included mapping the distribution and depth of blanket peat at the site along with assessing the mineral subsoil / bedrock conditions beneath the peat at key development locations (i.e. proposed turbines & met mast, substations, temporary construction compounds, existing and proposed access roads, borrow pit locations, and walkover survey of the cable route). This data was used to inform the final layout design. In summary, site investigations to address the land, soil and geology section of the EIAR included the following:

- A total of over 290 no. peat probe depths were carried out by HES, MKO and FTC, to determine the depth and geomorphology of the blanket peat at the site and cable route;
- A Geotechnical Peat Stability Assessment by FTC (December 2019);
- Gouge cores were undertaken at key development locations (i.e. turbine, substation, borrow pits and compound) to investigate peat and mineral subsoil lithology;
- A trial pit investigation and subsoil laboratory testing by Irish Drilling Ltd (IDL) in September 2019;
- Walkover survey and logging of bedrock outcrops and subsoil exposures; and,
- Mineral subsoils and peat were logged according to BS:5930 and Von Post Scale respectively.

The Geotechnical Peat Stability Assessment report prepared by FTC which includes the IDL Geotechnical Investigation Report is included as Appendix 9-1 of this EIAR.

9.2.3 Scoping and Consultation

The scope for the EIAR has been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process is outlined in Section 2.6 of this EIAR. There were no scoping responses with respect to land, soils and geology.

9.2.4 Impact Assessment Methodology

Using information from the desk study and data from the site investigation, an estimation of the importance of the soil and geological environment within the study area is assessed using the criteria set out in Table 9-1 (NRA, 2008).

Table 9-1 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.

Importance	Criteria	Typical Example
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 impacts require that likely impacts are described with respect to their extent, magnitude, complexity, probability, duration, frequency, reversibility and transfrontier nature (if applicable). The descriptors used in this environmental impact assessment report are those set out in EPA (2002) Glossary of Impacts 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 9-2.

In order to provide an understanding of this descriptive system in terms of the geological/hydrological environment, elements of this system of description of impacts are related to examples of potential impacts on the hydrology and morphology[1] of the existing environment, as listed in Table 9-3.

Table 9-2 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

[1] *Geological form or structure*

Impact Characteristic	Degree/ Nature	Description
		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 9-3 Impact descriptors related to the receiving environment.

Impact Characteristics		Potential Geological and 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. › Extent of floodplains. Mitigation measures can mitigate the impact OR residual impacts occur, but these are consistent with existing or emerging trends.
Positive,	Slight	Local perceptible time dependent impacts not requiring

Impact Characteristics		Potential Geological and Hydrological Impacts
Quality	Significance	
Negative or Neutral		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.

9.2.5 Limitations and Difficulties Encountered

No significant limitations or difficulties were encountered during the preparation of the Land, Soils and Geology Chapter of the EIAR.

9.3 Existing Environment

9.3.1 Site Description and Topography

The Proposed Development site is located approximately 4km to the northeast of Creegh, Co. Clare. The permitted Cahermurphy Phase I Windfarm (operational) is located immediately to the east of the site.

The elevation of the wind farm site, which has a total area of ~538ha, ranges between 90 – 150m OD (Ordnance Datum). The proposed windfarm infrastructure as described in Chapter 4, Section 4.3 excluding the cable route is located across an east – west orientated ridge which slopes away to the north, south and west. The majority of the ridge slopes steadily in a south-westerly direction from the topographic high point which exists on the east of the wind farm site. The north facing aspect of the ridge slopes more steeply to the northwest. The lower-lying lands to the north and south of the ridge have a more undulating topography.

The wind farm site comprises mainly of forestry planted on blanket bog with some poorly draining agricultural land on the east of the site. The wind farm site is accessible via a number of existing forestry and farm tracks. A public road separates the wind farm site from the eastern section of Cahermurphy Phase I Windfarm.

Apart from forestry, which is the predominant landuse, the wind farm site is also used for small scale peat cutting and farming.

The cable route to the Booltaigh Substation comprises underground cabling, measuring approximately 12.1 km in total, located on existing forestry and agricultural land and within the public road corridor,

The replanting lands (34.11ha) are located in counties Roscommon, Clare, Galway and Cavan. The baseline environment, potential direct, indirect and cumulative impacts of replanting lands on soils and geology has been assessed in the Section 6 of Appendix 4-3 Assessment of Forestry Replacement Lands.

The hen harrier enhancement area is approximately 1.5 kilometres from the hen harrier territory at Doo Lough. The area is currently dominated by commercial forestry and contains crags with remnant stands of heather.

9.3.2 Soils and Subsoils

The published soils map (www.epa.ie) for the Proposed Development study area (including enhancement lands and haul route works) show that blanket peat is the dominant soil type with areas of poorly draining mineral soil (AminPD) and poorly drained peaty soil (AminPDPT) being mapped on the northern and south-eastern slopes of the wind farm site.

A map of the local subsoil cover is attached as Figure 9-1 (www.gsi.ie). Blanket peat is mapped over most of the wind farm site with sandstone and shale tills mapped on the northern and south eastern slopes of the wind farm site. The mapped subsoils along the cable route is mainly blanket peat with localised sections of sandstone and shale tills and bedrock outcrop/subcrop.

Over 290 no. peat probes were undertaken within the proposed wind farm site. A gouge core was also undertaken at each of the key development locations (i.e. turbines, substation options 1 and 2, 2 no. borrow pits and compound) to investigate peat and mineral subsoil lithology.

Peat depths at the wind farm site ranged from 0 to 2.7m with an average of 0.7m. Over 95 percent of peat depth probes recorded peat depths of less than 3.0m. The peat depths recorded at the turbine locations varied from 0.25 to 2.6m with an average depth of 0.7m.

With respect to the existing and proposed access roads, peat thicknesses are typically less than 1.5m with localised depths of 2.5m. A summary peat depth map for the wind farm site is shown as Figure 9-2.

The average peat depth across the cable route is 1m with 42% being less than 0.5m and 65% being less than 1m. Peat depths greater than 2m were typically confirmed to localised discrete pockets. A peat depth map for the cable route is shown as Figure 9-3.

A trial pit investigation was carried out at the wind farm site by Irish Drilling Ltd (IDL) during September 2019. The ground investigation comprised 14 no. trial pits and was carried out on 18th and 19th September 2019. Laboratory testing of samples was carried out by IDL. The trial pits were carried out at the turbine locations (10 no.), 2 no. substation options (SS1 and SS2), construction compound and the 2 no. borrow pit locations (BP1 and BP2). Trial pits were terminated at approximately 4m where no (shallower) refusal was encountered. The locations of the trial pits are shown on Figure 9-2. A summary of the trial pit geological logs is presented in Table 9-4 below and the complete geological logs are attached as Appendix 9-1.

Mineral subsoils were typically described as firm to stiff, slightly sandy gravelly SILT/CLAY or SILT over silty sandy GRAVEL which is underlain by boulders at some locations. Cobbles and boulders were typically noted as angular and sub-rounded and rounded. Rock (bedrock presumed) was encountered in 5 no. trial pits (i.e. T6, T7, SS1, BP1 and BP2) and refusal on boulders occurred at 4 no. locations (T1, T2, T3 and T5). It is likely that the boulders indicate that the top of bedrock is close.

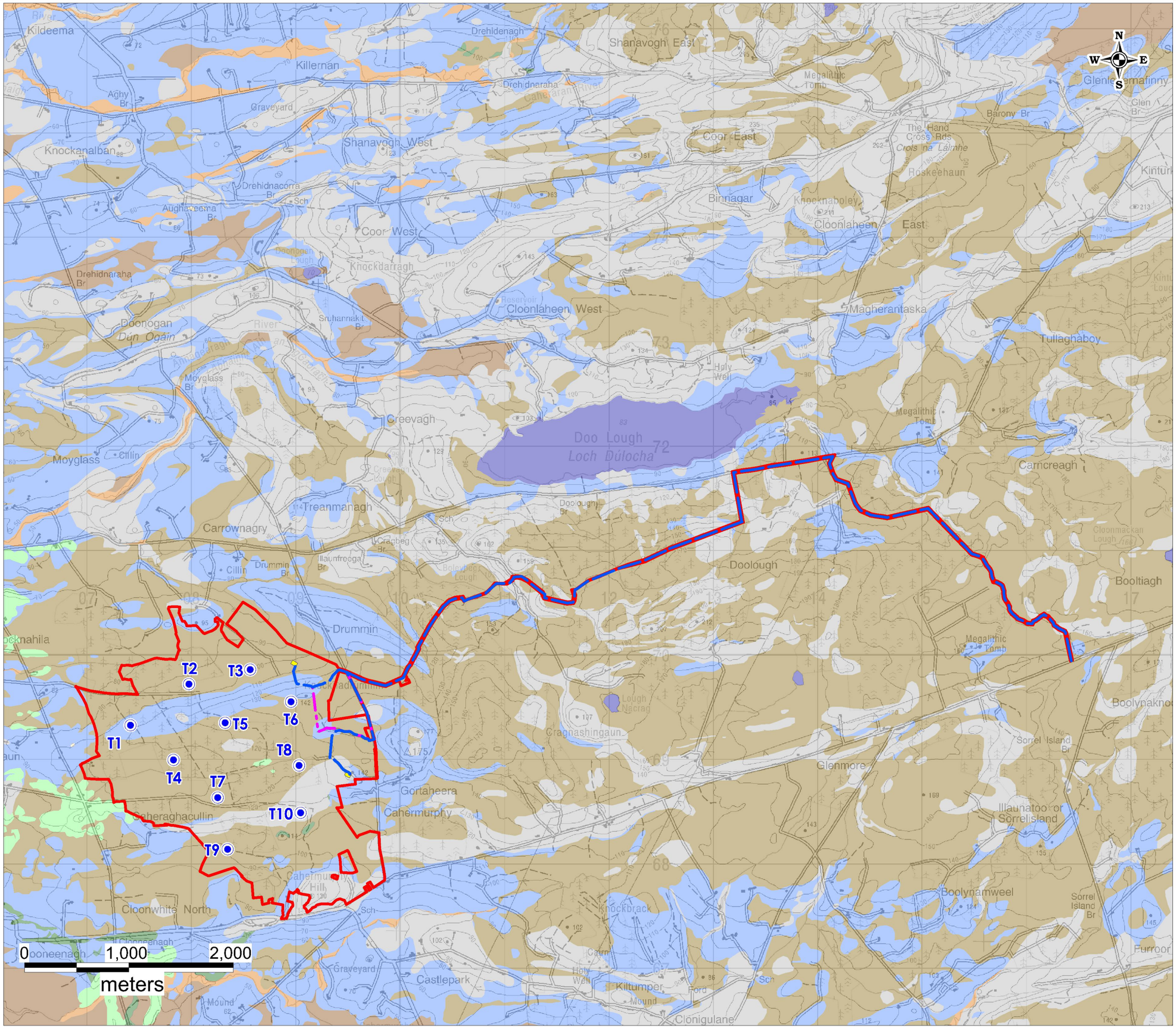
Where bedrock in the trial pits was encountered it was described as weathered bedrock comprising angular gravel and angular/flat cobbles of shale/siltstone.

Table 9-4 Summary of Peat Depths & Mineral Subsoil Lithology at Proposed Turbine Locations

Infrastructure Ref.	Average Peat Depth (m)	Mineral Subsoil Lithology (Summary Trial Pit Logs)
T1	0.25	Very stiff brown sandy SILT (0.8 – 1.2m), over brown silty locally very silty very sandy coarse GRAVEL (1.2 – 3.9m). Refusal on boulders.
T2	0.15	Stiff orangish brown SILT (0.2 – 0.4m), over dark grey silty sandy GRAVEL (0.4 – 3.3m).

Infrastructure Ref.	Average Peat Depth (m)	Mineral Subsoil Lithology (Summary Trial Pit Logs)
		Refusal on boulders.
T3	0.4	Topsoil on firm brownish grey SILT (0.25 – 0.85m), over stiff brown slightly gravelly sandy SILT (0.85-1.3m), over brown silty gravelly medium to coarse SAND (1.3 – 1.8m), over orange brown very sandy very silty coarse GRAVEL (1.8 – 3.5m). Refusal on boulders.
T4	1.8	Stiff bluish grey slightly sandy slightly gravelly SILT (2.7 – 4m).
T5	0.25	Stiff bluish grey and brown SILT (0.35 – 0.85m), over stiff brown and grey slightly sandy gravelly SILT/CLAY (0.85 – 3.9m). Refusal on boulders.
T6	0.25	Stiff light brown organic SILT (0.4 – 0.7m), over bluish grey very sandy very silty coarse GRAVEL (0.7m – 1.6m), over grey silty sandy coarse GRAVEL (1.6 – 2.6m). Refusal on rock (bedrock presumed).
T7	0.85	Soft light brown organic SILT (0.45 – 0.7m), over stiff bluish grey gravelly SILT (0.7 – 1.4m), over stiff damp dark grey slightly sandy gravelly SILT (1.4 – 2.8m). Refusal on rock (bedrock resumed).
T8	1.9	Firm light brown organic SILT (0.25 – 0.55m), over bluish grey silty sandy angular to subangular fine to coarse GRAVEL (0.55 – 1.9m), over stiff brown sandy gravelly CLAY (1.9 – 2.5m), over light grey silty sandy coarse GRAVEL (2.5 – 4.3m).
T9	0.35	Soft light brown fibrous organic SILT (0.3 – 0.65m), over stiff bluish grey slightly sandy slightly gravelly SILT (0.65 – 1.8m), over stiff damp light brown slightly sandy gravelly SILT (1.8 – 3.3m), over wet brown silty sandy angular coarse GRAVEL (3.3 – 4m).
T10	0.15	Stiff light brown slightly gravelly SILT (0.6 -2m), over brownish grey sandy very silty coarse GRAVEL (2.2 – 3.5m), over stiff dark bluish grey gravelly SILT (3.5 – 4.6m).
Substation 1	0.15	Stiff greyish blue slightly gravelly SILT (0.2 – 2m), over brown clayey coarse GRAVEL (2 – 3.7m). Refusal on rock (bedrock presumed).
Substation 2	0.8	Stiff bluish grey and brown slightly sandy gravelly SILT (0.4 – 2.6m), over grey slightly sandy silty coarse GRAVEL (2.6 – 3.2m), over soft damp grey sandy gravelly SILT (3.2 – 4m).

Infrastructure Ref.	Average Peat Depth (m)	Mineral Subsoil Lithology (Summary Trial Pit Logs)
Compound	0.15	See T5 log above (TP05 was completed in the area of T5 and the construction compound).
BP1	0.15	Soft light brown sandy gravelly SILT (0.4 – 1m), over light brown silty gravelly fine to coarse SAND (1 – 1.7m), over greyish brown slightly silty coarse SAND (1.7 – 2.2m), over greyish brown slightly silty sandy and angular and elongate GRAVEL (2.2 – 2.8m), over weathered rock – elongate angular and flat SHALE rock (2.8 – 4.1m). Bedrock presumed @ 4.1m.
BP2	0.3	Brown gravelly medium to coarse SAND (0 – 0.9m). Refusal on rock (bedrock assumed).



Legend

- EIAR Site Boundary
- Proposed Turbine Layout
- Proposed Cable Route
- Proposed Alternative Cable Route
- Proposed Electricity Substation Compound

- Alluvium
- Eskers comprised of gravels of acidic reaction
- Blanket Peat
- Gravels derived from Namurian sandstones and shales
- Bedrock outcrop or subcrop
- Till derived from Namurian sandstones and shales
- Water

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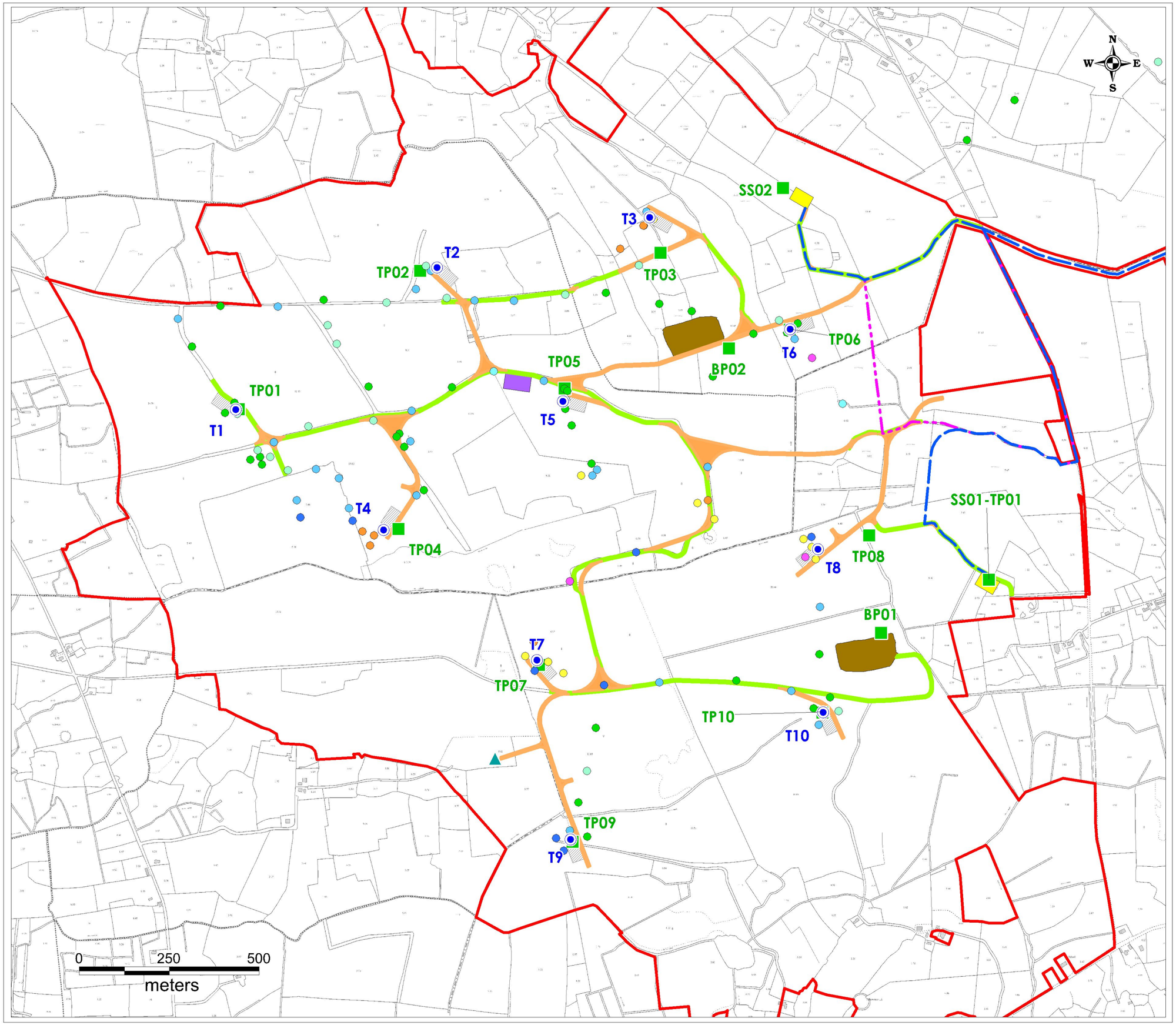
Client: MKO	
Job: Cahermurphy WF, Co. Clare	
Title: Local Subsoils Map	
Figure No: 9-1	
Drawing No: P1477-0-0720-A3-9-1-0A	
Sheet Size: A3	Project No: P1477-0
Scale: 1:35,000	Drawn By: GD
Date: 14/07/2020	Checked By: MG



Legend

- EIAR Site Boundary
- Proposed Turbine Layout
- Proposed Met Mast
- Proposed Electricity Substation Compound
- Proposed Borrow Pit
- Proposed Construction Compound
- Existing Road to be Upgraded
- Proposed New Road
- Proposed Hardstanding
- Proposed Cable Route
- Proposed Alternative Cable Route
- Trial Pit Location

Peat Depth Legend

- 0 - 0.5m
- 0.5 - 1.0m
- 1.0 - 1.5m
- 1.5 - 2.0m
- 2.0 - 2.5m
- 2.5 - 3.0m
- 3.0 - 3.5m

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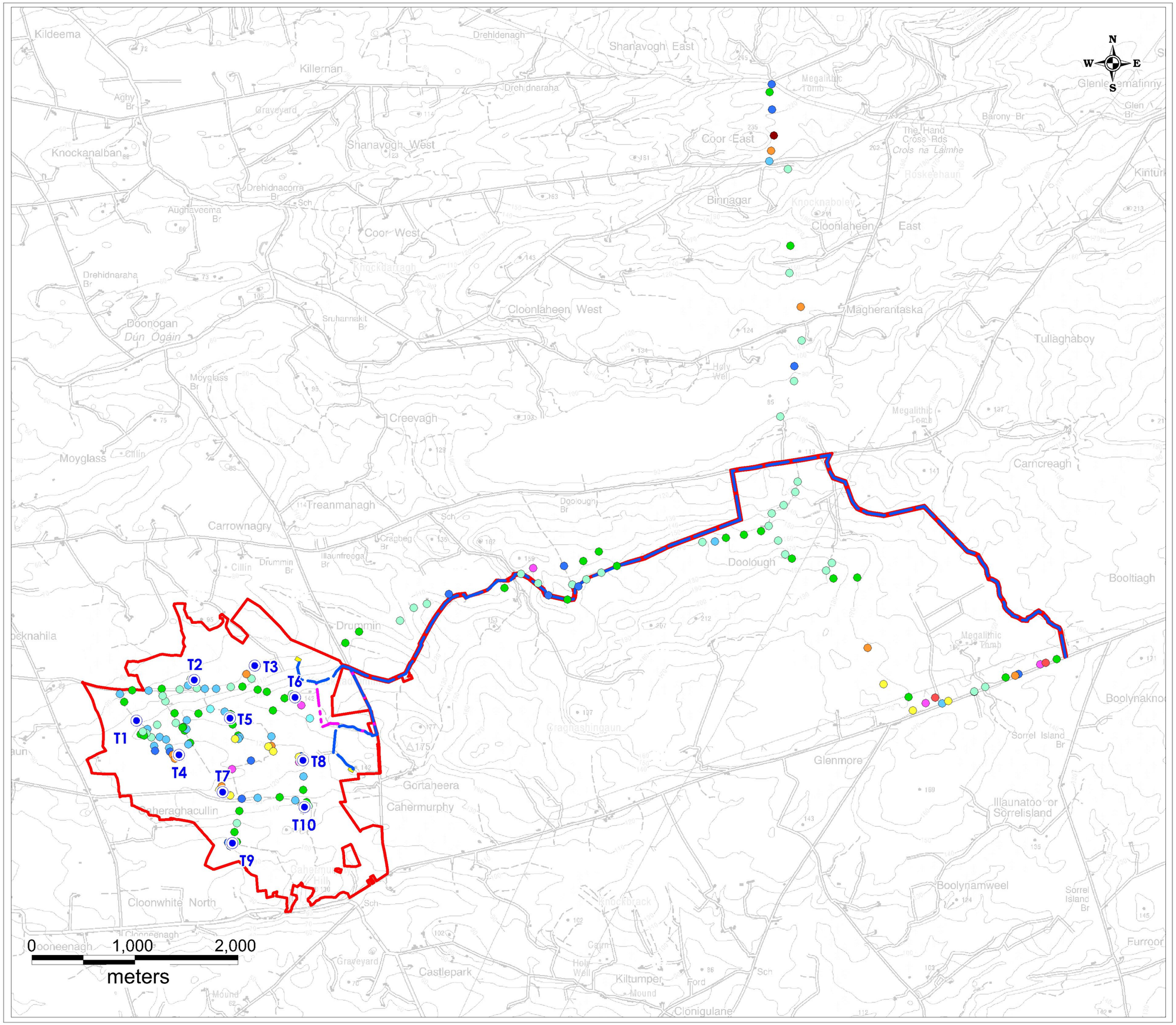
Client: MKO	
Job: Cahermurphy WF, Co. Clare	
Title: Wind Farm Site Investigation Map	
Figure No: 9-2	
Drawing No: P1477-0-0720-A3-9-2-0A	
Sheet Size: A3	Project No: P1477-0
Scale: 1:10,000	Drawn By: GD
Date: 14/07/2020	Checked By: MG



Legend

- EIAR Site Boundary
- Proposed Turbine Layout
- Proposed Cable Route
- Proposed Alternative Cable Route
- Proposed Electricity Substation Compound

Peat Depth Legend

- 0 - 0.5m
- 0.5 - 1.0m
- 1.0 - 1.5m
- 1.5 - 2.0m
- 2.0 - 2.5m
- 2.5 - 3.0m
- 3.0 - 3.5m
- 3.5 - 4.0m
- 5.0 - 5.5m

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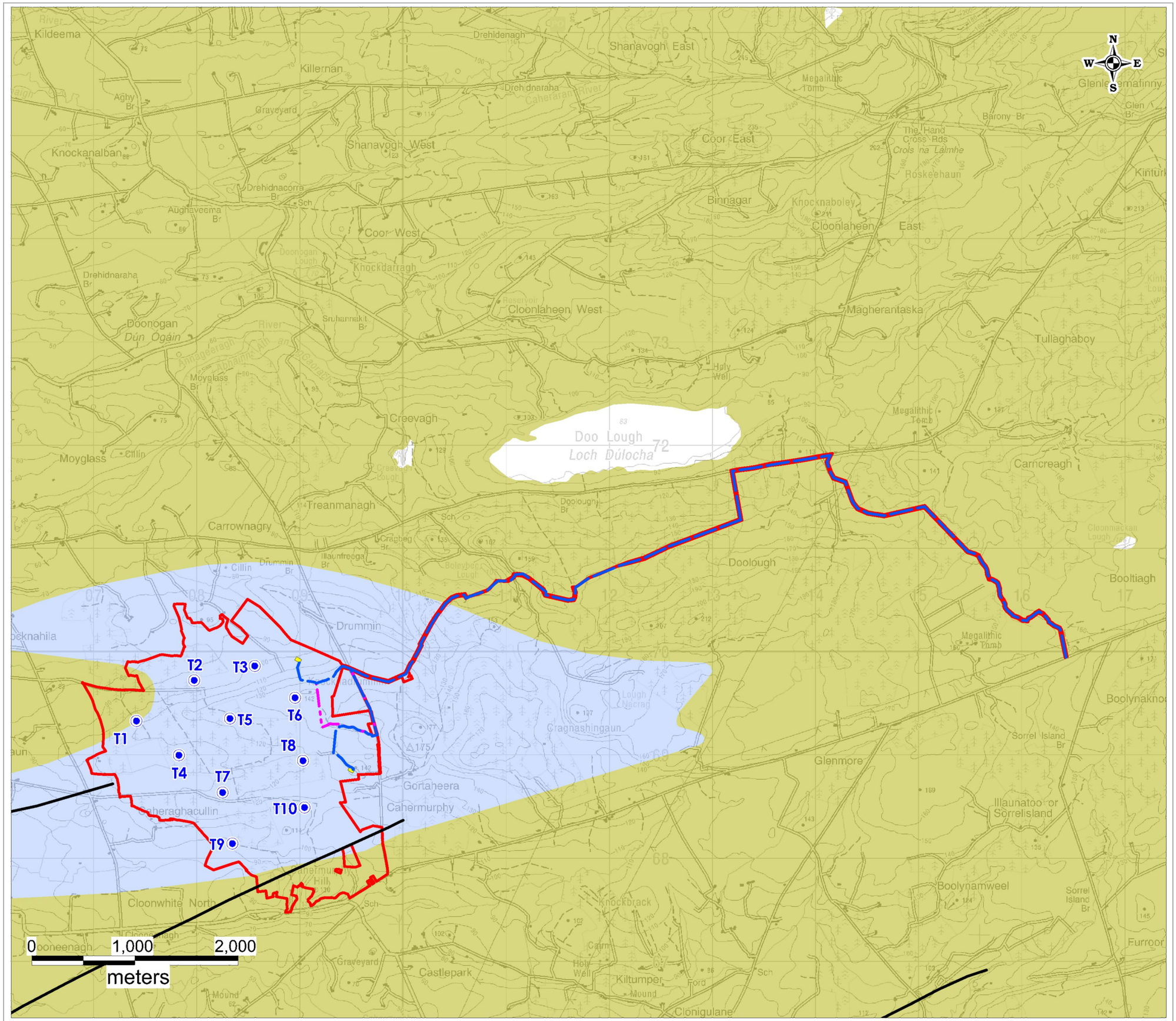
Client: MKO	
Job: Cahermurphy WF, Co. Clare	
Title: Peat Depth Map	
Figure No: 9-3	
Drawing No: P1477-0-0720-A3-9-3-0A	
Sheet Size: A3	Project No: P1477-0
Scale: 1:35,000	Drawn By: GD
Date: 14/07/2020	Checked By: MG



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Client: MKO	
Job: Cahermurphy WF, Co. Clare	
Title: Local Bedrock Geology Map	
Figure No: 9-4	
Drawing No: P1477-0-0720-A3-9-4-0A	
Sheet Size: A3	Project No: P1477-0
Scale: 1:35,000	Drawn By: GD
Date: 14/07/2020	Checked By: MG

9.3.3 Bedrock Geology

The underlying bedrock strata at the study area (including the wind farm and cable route sites) are mapped by the GSI as mainly the Gull Island Formation. It is described as grey slumped siltstones with up to 20% usually graded sandstone at the base of the succession, decreasing towards the top.

There are some bedrock exposures visible along the central ridgeline of the wind farm site near proposed borrow pit no. 2, where the bedrock was noted to comprise of broken, slightly weathered, blocky siltstone/sandstone clasts. Bedrock is also visible near borrow pit no. 1 as shown in Plate 9-2 below.

A bedrock geology map is shown as Figure 9-4.

There are no mapped fault lines on the site or the immediate surrounding study area.

Plate 9-2 Bedrock Exposure Near to Proposed Borrow Pit 1

9.3.4 Geological Resource Importance

The siltstone/sandstone bedrock at the site are classified as “Low” importance because it is locally abundant. The bedrock could be used on a “sub-economic” local scale for construction purposes.

The peat deposits at the site are 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 forestry related drainage and rill ploughing. Similar peat deposits are also locally abundant in the study area. Refer to Table 9-1 for criteria.

9.3.5 Geological Heritage and Designated Sites

There are no recorded Geological Heritage sites, mineral deposit sites or mining sites (current or historic) within 5km of the proposed development area.

9.3.6 Soil Contamination

There are no known areas of soil contamination on the site of the Proposed Development. During the site walkovers, no areas of contamination concern were identified.

According to the EPA online mapping (http://gis.epa.ie/Envision), there are no licensed waste facilities on or within the immediate environs of the site of the Proposed Development.

There are no historic mines at or in the immediate vicinity of the site of the Proposed Development that could potentially have contaminated tailings.

9.3.7 Economic Geology

The GSI online Aggregate Potential Mapping Database shows that the Proposed Development site is located within an area mapped as being typically Very Low to Low in terms of crushed rock aggregate potential and with no potential for granular aggregate potential (i.e. potential for gravel reserves).

9.3.8 Peat Stability Assessment

This section summarises the report on assessment of peat stability undertaken by FTC. The Geotechnical Peat Stability Assessment report is included as Appendix 9-1 of this EIAR.

An analysis of peat sliding was carried out at all the main infrastructure locations across the wind farm site as shown on Figure 9.2 for both the undrained and drained conditions. The purpose of the analysis was to determine the Factor of Safety (FoS) of the peat slopes. 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 9-5.

No peat failures/landslides are recorded on the wind farm site which suggests that site conditions do not pre-dispose themselves to failures/landslides.

A walkover survey and peat probing of the grid connection route identified no peat stability issues and therefore there was no requirement to carryout the detailed analysis as described below for the wind farm site.

Table 9-5 Probability Scale for Factor of Safety for Peat

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	1.19 to 1.11	Probable
5	<1.0	Very Likely

9.3.8.1 Peat Stability Assessment Results

Undrained Analysis[2]

The results of the undrained analysis for the peat at the proposed infrastructure locations are presented in Table 9-6. The analysis was done for 2 no. conditions which are described in a footnote to the table.

Table 9-6 Factor of Safety Results (undrained condition)

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition[3]	
			Condition (1)	Condition (2)
T1	507385	669377	51.02	11.77
T2	507942	669772	51.02	11.77
T3	508531	669911	30.61	10.2
T4	507833	669002	8.82	6.37
T5	508291	669400	45.99	9.2
T6	508921	669600	57.34	16.38
T7	508219	668683	6.76	4.26
T8	508965	668990	9.17	6.55
T9	508312	668187	32.77	13.49
T10	509012	668538	30.71	7.09
Substation 1	508888	669971	152.91	19.95
Substation 2	509457	668893	28.67	12.74
Construction Compound	508164	669452	102.05	13.31
Met Mast	508107	668404	9.45	3.89
Borrow Pit 1	507398	669233	61.43	8.01
Borrow Pit 2	508725	669570	25.65	5.92

[2] An undrained analysis was carried out, which applies in the short-term during construction. The undrained analysis would be considered the most critical condition for the peat slopes.

[3] *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.*

Drained Analysis[4]

The results of the drained analysis for the peat at the proposed infrastructure locations are presented in Table 9-7.

Table 9-7 Factor of Safety Results (drained condition)

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
T1	507385	669377	25.51	12.73
T2	507942	669772	25.51	12.73
T3	508531	669911	15.31	11.03
T4	507833	669002	4.41	6.89
T5	508291	669400	22.99	9.93
T6	508921	669600	28.67	17.73
T7	508219	668683	3.38	4.6
T8	508965	668990	4.59	7.09
T9	508312	668187	16.38	14.6
T10	509012	668538	15.36	7.64
Substation 1	508888	669971	76.46	21.58
Substation 2	509457	668893	9.57	9.2
Construction Compound	508164	669452	51.02	14.39
Met Mast	508107	668404	4.72	4.18
Borrow Pit 1	507398	669233	38.32	10.8
Borrow Pit 2	508725	669570	30.71	8.64

The calculated FoS for undrained and drained conditions for the locations analysed, show that all locations have an acceptable FoS of greater than 1.3, indicating a negligible/none (refer to Table 9-5) risk of peat failure.

In summary, the findings of the geotechnical assessment showed that the Proposed Development site has an acceptable margin of safety and is suitable for the wind farm site and grid connection. Overall,

[4] A drained analysis was carried out, which examines the effect of in particular, rainfall on the existing stability of the natural peat slopes on site.

the peat characteristics on the wind farm site and grid connection cable route are similar to that encountered on many developed wind farm sites.

9.4 Characteristics of the Proposed Development

The Proposed Development (wind farm and cable route) will involve removal of peat, subsoil and bedrock for hardstanding and access track emplacement, and also during excavations along the cable route. Minor temporary earthworks will also be completed along the turbine delivery route as described in Chapter 15, Section 15.1.8. Crushed rock for construction will be sourced from 2 no. proposed borrow pits. It is proposed that these borrow pits will be reinstated with peat and spoil excavated as part of the construction phase of the Proposed Development.

Estimated volumes of peat, subsoil and bedrock to be removed are shown in Table 9-8 and Table 9-9 respectively. Not all of the peat and soil excavated will be sent to the borrow pits for reinstatement, portion will be cast aside (i.e. side cast) and used for reinstatement and landscaping works around the site. Any bedrock excavated during cut and fill works will be used for filling along the development footprint.

Spoil arisings from the cable route will be used as backfill in the first instance, any excess arisings not suitable for backfill will be side cast[5] along the route. If there are locations where site casting is not suitable, arisings will be deposited in the on-site borrow pits.

Further details are provided in the Peat and Spoil Management Plan for the works which is included in Appendix 4-2.

The Project also includes tree replanting and hen harrier enhancement areas which are located outside the Proposed Development site.

Table 9-8 Worst Case Peat, Mineral Soil (Spoil) Excavation Volumes

Development Component	Peat (m^3)	Spoil – Non-Peat (m^3)
10 No. Turbines & Hardstands	26,415	16,757
Access Roads/Junction works	45,322	103,320
Borrow Pits (2 no.)	9,900	37,450
Met Mast	283	4,195
Substation 1	648	
Substation 2	3,456	
Construction Compound	1,968	

[5] *Material will be placed to one or both sides of the works area (i.e. along access roads) and stored permantely at that location. The material will be sealed vegetation will grow on the sidecast material over time.*

Development Component	Peat (m^3)	Spoil – Non-Peat (m^3)
Cable route	4,125	
Total	**92,117**	**161,722**

Note: A bulk factor of 20% has been applied to excavation volumes as a worst case estimate

Table 9-9 Estimated Borrow Pit Rock Resource Volumes

Borrow Pit No.	Volume (m^3)
BP1	105,000
BP2	98,500
Estimated Total	**203,500**

9.5 Likely and Significant Impacts on Land, Soils and Geology

9.5.1 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. Commercial forestry operations would continue at the site.

Drainage carried out in areas of existing access road and coniferous plantations and farmland continue to function and may be extended in the case of coniferous plantation. Coniferous forestry will be felled as forestry compartments reach maturity. Re-planting of these areas with more coniferous trees is likely to occur. Plantations will be reploughed where necessary to facilitate afforestation.

The land, soils and geology would remain largely unaltered as a result of the Do-Nothing Scenario.

9.5.2 Likely Impacts and Mitigation Measures – Construction Phase

The likely impacts of the proposed development and mitigation measures that will be put in place to eliminate or reduce them are shown below.

9.5.2.1 Peat, Subsoil Excavation and Bedrock Excavation

Excavation of peat, subsoil and bedrock will be required for site levelling and for the installation of infrastructure and foundations for the access roads and turbines and all elements of the proposed project listed in Table 9-8. This will result in a permanent removal of peat, subsoil and bedrock at excavation locations. Estimated volumes of peat and bedrock to be removed are shown in Table 9-8 and Table 9-9 above.

Pathway: Extraction/excavation.

Receptor: Peat, subsoil and bedrock

Potential Pre-Mitigation Impact: Negative, slight/moderate, direct, Likely, permanent impact on peat, subsoil and bedrock.

Proposed Mitigation Measures:

- Placement of turbines and associated infrastructure in areas with shallow peat where possible;
- Use of the existing road network to reduce peat excavation and borrow pit volumes;
- Upgrade of existing floating roads (where acceptable to do so) to reduce peat excavation volumes;
- The peat and subsoil which will be removed during the construction phase will be localised to the Proposed Development infrastructure;
- No turbines or related infrastructure will be constructed near or on any designated sites such as NHAs, SACs or SPAs; and,
- 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.

Residual Impact: The granular soil/peat deposits and bedrock at the site is classified as of "Low" and "Low" importance respectively. The peat is already degraded by forestry and drainage. The overall site area is extensive while the proposed development footprint is approximately 2.8% of the overall site area. The impact is the disturbance and relocation of c 253,839m^3 of peat and spoil during construction. The design measures incorporated into the project as described above in particular the avoidance of deeper peat areas combined with the 'low' importance of the deposits means that the residual effect is considered Negative, direct, slight, Likely, permanent impact on peat, subsoil and bedrock.

Significance of Effects: For the reasons outlined above, no significant effects on land, soils, subsoils or bedrock will occur.

9.5.2.2 Contamination of Soil by Leakages and Spillages and Alteration of Peat/Soil Geochemistry

Plant and machinery will be run on oils and fuels. Oils will also be present in the substation. Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a significant pollution risk to land, soils and associated ecosystems. The accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, and is persistent in the environment.

Pathway: Peat, subsoil and bedrock pore space.

Receptor: Peat, subsoil and bedrock.

Potential Pre-Mitigation Impact: Negative, direct, slight, short term, unlikely impact on peat, subsoil and bedrock.

Proposed Mitigation Measures:

- On site re-fuelling will be undertaken using a double skinned bowser with spill kits on the ready for accidental leakages or spillages;
- On site re-fuelling will be undertaken by suitably trained personnel only;

- Fuels stored on site will be minimised. Storage areas where required will be bunded appropriately for the fuel storage volume for the time period of the construction and fitted with a storm drainage system and an appropriate oil interceptor;
- The electrical substation will be bunded appropriately to the volume of oils likely to be stored, and to prevent leakage of any associated chemicals and to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose;
- All waste tar material arising from the chipping and resurfacing of the temporary construction access road will be removed off-site and taken to licenced waste facility; and,
- An emergency plan for the construction phase to deal with accidental spillages is contained within the Construction and Environmental Management Plan (Appendix 4.4 of this EIAR). Spill kits will be available to deal with and accidental spillage in and outside the re-fuelling area.

Residual Impact: 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: For the reasons outlined above, no significant effects on land, soils, subsoils or bedrock will occur.

9.5.2.3 Erosion of Exposed Subsoils and Peat During Tree Felling and Construction Works

Peat and spoil removed from turbine locations and access roads and all elements of the proposed project listed in Table 9-8, will be used for landscaping, cast aside alongside designated access roads and used to reinstate the 2 no. proposed borrow pits. Where possible, the peat acrotelm (surface vegetation layer) 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 borrow pits. Re-seeding and spreading/planting of heather and moss cuttings will also be carried out in these areas. These measures will prevent erosion of stored peat in the short term until vegetation has established and binds the peat/soils together and presents erosion. A full Peat and Spoil Management Plan for the development is presented as Appendix 4-2.

Pathway: Peat, subsoil and bedrock pore space.

Receptor: Peat, subsoil and bedrock.

Potential Pre-Mitigation Impact: Negative, direct, slight, short term, unlikely impact on peat, subsoil and bedrock.

Mitigation:

All excavated material will be completed in accordance with the Peat and Spoil Management Plan. Material will be moved over the least possible distance.

Any excess peat will be moved to peat storage areas or will be temporarily surrounded by earthen berms to prevent erosion. This will prevent erosion of soil. Silt fences will be installed around temporary stockpiles to limit movement of entrained sediment in surface water runoff. The use of earthen berms and silt fencing around earthworks and spoil mounds will prevent egress of water from the works.

In order to minimize erosion of mineral subsoils stripping of peat will not take place during extremely wet periods[6] (to prevent increased silt rich runoff). Temporary drainage systems (as outlined in Section 10.5.3.2 of the Chapter 10) will be required to limit runoff impacts during the construction phase.

During tree felling brash mats will be used to support vehicles on soft ground, reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place when they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting.

Residual Impact: 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 the 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: For the reasons outlined above, no significant effects on land, soils, subsoils or bedrock are wil occur.

9.5.2.4 Peat Instability and Failure

Peat instability or failure refers to a significant mass movement of a body of peat that would have a significant effect on the proposed wind farm site and the surrounding environment. Peat failure excludes localised movement of peat that could occur below an access road, creep movement or erosion type events. The consequence of peat failure at the study area may result in:

- Death or injury to site personnel;
- Damage to machinery;
- Damage or loss of access tracks;
- Drainage disrupted;
- Site works damaged or unstable;
- Contamination of watercourses, water supplies by particulates;
- Degradation of the environment.

Pathway: Vehicle movement and excavations.

Receptor: Peat subsoils.

Potential Pre-Mitigation Impact: Direct, negative, significant, unlikely impact on peat and subsoils.

Mitigation Measures:

Based on the recommendations and control measures given in the FTC Geotechnical Peat Stability Assessment (Appendix 9-1) report being strictly adhered to during construction and the detailed stability assessment carried out for the peat slopes which showed that the site has an acceptable margin of safety, there is a negligible/none risk of peat instability/failure at the wind farm site (i.e. all elements of the proposed wind farm infrastructure and grid connection as listed in Table 9-6 and Table 9-7).

[6] >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.

The risk assessment at each turbine location identified a number of control measures to reduce further the potential risk of peat failure. Access roads to turbines will be subject to the same relevant control measures that apply to the nearest turbine.

The following 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 will 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 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;
- Ensure construction method statements are followed or where agreed modified/ developed; and,
- Revise and amend the Geotechnical Risk Register as construction progresses.

Please refer to Appendix 9-1 for proposed turbine specific, road section and grid connection mitigation measures.

Residual Impacts: 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 - Negative, imperceptible, direct, low probability, permanent effect on peat and subsoils.

Significance of Effects:

For the reasons outlined above, no significant effects on land, soils, subsoils or bedrock will occur.

9.5.2.5 Turbine Delivery Route Works

Minor earthworks are required for turbine delivery. These include for temporary widening of existing roads and junctions. These TDR works are described in Section 15.1.8.1 of the EIAR.

Pathway: Extraction/excavation/landscaping.

Receptor: Peat and subsoil

Potential Pre-Mitigation Impact: Negative, imperceptable, direct, likely, temporary effect on land, peat and subsoil.

Proposed Mitigation Measures:

- All works are minor and locaised and cover very small areas;
- These works are distributed over a wide area; and,
- All works are temporary in nature.

Residual Impact: The TDR related earthworks are minor in nature and will be temporary in durations. They are also separated from each other by considerable distances. Residual effects are Negative, imperceptable, direct, likely, temporary effect on land, peat and subsoil.

Significance of Effects: For the reasons outlined above, no significant effects on land, soils or subsoils will occur.

9.5.3 Assessment of Health Effects

Potential health effects arise mainly through the potential for soil and ground contamination. Based on our experience wind farms are not a significant source of contamination so the potential for effects during the operational phase are negligible. Hydrocarbons will be used onsite during construction and operational phases, however the volumes will be small in the context of the scale of the Proposed Development and will be handled and stored in accordance with best practice mitigation measures as described in detail in Section 9.5.2.2, Section 9.5.4.2 and Section 9.5.4.3. The potential residual impacts associated with soil or ground contamination and subsequent health effects are imperceptible. Health effects relating to incidences of landslide/peat movement are not anticipated as the risk of peat slide has been assessed as negligible/none.

9.5.4 Likely Impacts and Mitigation Measures – Operational Stage

Very few potential direct impacts are envisaged during the operational phase of the Proposed Development. These may include:

- Maintenance of site roads;
- Some construction vehicles or plant will 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.

9.5.4.1 Site Road Maintenance duing Operational Stage

In relation to indirect impacts a small amount of granular material will be required to maintain access tracks/site roads during operation which will place intermittent minor demand on local quarries. Please note the on-site borrow pit will have been reinstated with excavated peat and spoil following the construction stage and will not be available to source aggregate during the operational phase.

Pathway: Peat, subsoil and bedrock pore space.

Receptor: Peat, subsoil and bedrock.

Potential Pre-Mitigation Impact: Negative, indirect, imperceptible, short term, likely impact bedrock

Proposed Mitigation Measures:

- Use of aggregate from authorised quarries for use in road and hardstand maintenance.

Residual Impact: The use aggregate for site road maintenance will be minor and infrequent, and all material will be imported to the site from local authorised quarries. The residual effect is considered to be - Negative, imperceptible, indirect, short-term, low probability effect on bedrock.

Significance of Effects: For the reasons outlined above, no significant effects on land, soils or geology will occur.

9.5.4.2 Site Vehicle/Plant Use During Operational Stage

Plant and site vehicles used in site maintenance will be run on fuels and use hydraulic oils. Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a significant pollution risk to land, soils and associated ecosystems. The accumulation of small spills of fuels and lubricants

during routine plant use can also be a pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, and is persistent in the environment.

Pathway: Peat, subsoil and bedrock pore space.

Receptor: Peat, subsoil and bedrock.

Potential Pre-Mitigation Impact: Negative, direct, slight, short term, unlikely impact on peat, subsoil and bedrock.

Proposed Mitigation Measures:

- Vehicles used during the operational phase will be refulled off site before entering the site;
- No fuels will be stored on-site during the operational phase; and
- Spill kits will be available in all site vehicles to deal with and accidental spillage and breakdowns; and,
- An emergency plan for the operational phase to deal with accidental spillages and breakdowns will be contained in the Environmental Management Plan for the wind farm operational phase.

Residual Impact: The use of hydrocarbons in plant and vehiles is a standard risk associated with all operational wind farm 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: For the reasons outlined above, no significant effects on land, soils, subsoils or bedrock will occur.

9.5.4.3 Use of Oils in Turbine Transformers During Operational Stage

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. Hydrocarbon has a high toxicity to humans, and all flora and fauna, and is persistent in the environment.

Pathway: Peat, subsoil and bedrock pore space.

Receptor: Peat, subsoil and bedrock.

Potential Pre-Mitigation Impact: Negative, direct, slight, short term, unlikely impact on peat, subsoil and bedrock.

Proposed Mitigation Measures:

- All transformers and substation areas will be bunded to 110% of the volume of oil used in each transformer/substation;
- An emergency plan for the operational phase to deal with accidental spillages will be contained in the Environmental Management Plan for the wind farm operational phase.

Residual Impact: The use of hydrocarbons in transformers and substations is a standard risk associated with all operational wind farm 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: For the reasons outlined above, no significant effects on land, soils, subsoils or bedrock will occur.

9.5.5 Likely Impacts and Mitigation Measures – Decommissioning Stage

The potential impacts associated with decommissioning of the proposed development will be similar to those associated with construction but at a reduced magnitude due to the reduced scale of the works. Please refer to Section 9.5.2 above.

During decommissioning, it will 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, and the substation. This will be done by covering hard surfaces 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 as the extent of the works will be less. 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 including the bases which will be rehabilitated by covering with local topsoil/peat in order to regenerate vegetation which will reduce runoff and sedimentation effects. 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 impacts on the land, soils and geology environment are envisaged during the decommissioning stage of the proposed development.

9.5.6 Risk of Major Accidents and Disasters

None, as indicated above the risk of a landslide at the wind farm site is determined to be negligible/none.

9.5.7 Post Construction Monitoring

None required as no significant effects are anticipated.

9.5.8 Potential Cumulative Impacts

The geological impact assessment undertaken above in this chapter outlines that significant effects are unlikely due to the localized nature of the construction works. Impacts on land soil and geology will not extend beyond the immediate vicinity of the Proposed Development Site (wind farm site and cable route). The proposed enhancement lands works will not have any effect on land, soils and geology.

Tree felling has a negligible effects on land, soils and geology as no significant excavations are required during tree felling and therefore the surrounding commercial forestry will not contribute to cumulative

effects associated with wind farm or cable route construction. It is also noted that all general forestry activity will be curtailed on the site during the construction of the proposed development.

Therefore, no cumulative impacts between the Proposed Development (wind farm and cable route), and other existing, permitted or proposed projects, listed in Section 2.7 of this EIAR, on land soils and geology will occur as there can be no interaction due to distance and separation.

The replanting lands are located in counties Roscommon, Clare, Galway and Cavan and therefore are not likely to contribute to potential cumulative impacts with the proposed wind farm development in terms of impacts on soils and geology. The potential direct, indirect and cumulative impacts of replanting lands on soils and geology has been assessed in the Section 6 of Appendix 4-3 Assessment of Forestry Replacement Lands.

9.5.9 Summary

Excavation of peat, subsoil and bedrock will be required for site levelling and for the installation of wind farm infrastructure. This will result in a permanent removal of peat, subsoil and bedrock at most excavation locations. Excavated peat will be utilized to re-instate the borrow pit locations (2 no.) and a portion of the excavated peat will also be used for reinstatement and landscaping works around the wind farm site or side cast at designated areas. The handling and management of peat will be undertaken in accordance with the Peat & Spoil Management Plan. Storage and handling of hydrocarbons/chemicals will be carried out using best practice methods (as outlined in Section 9.5.2.2). Measures to prevent peat and subsoil erosion during excavation, reinstatement and permanent placement in borrow pits will be undertaken to prevent water quality impacts. All works will be completed in accordance with the Peat and Spoil Management Plan (outlined in Chapter 7).

A peat stability assessment undertaken for the site shows that there is a negligible/none risk of peat instability/failure at the wind farm site and along the proposed construction access roads.

No significant impacts on the land, soil and geology of the wind farm and cable route site will occur during the construction and operational phases of the development, and none are anticipated during the decommissioning phase.

Our assessment also concludes that there will be no cumulative effects on the land soil and geology environment as a result of the proposed development.

10. WATER

10.1 Introduction

10.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by MKO to carry out an assessment of the potential impacts of the proposed Cahermurphy Phase Two Windfarm Project (i.e. 10 no. turbines at the wind farm site, grid connection cable route, haul route works, replacement planting lands and harrier enhancement area) on the water environment. The Proposed Development site which includes the windfarm and the grid connection cable route is located near Creegh, Co. Clare.

The objectives of the assessment are to:

- Produce a baseline study of the existing water environment (surface and groundwater natural resources) in the area of the Proposed Project;
- Identify likely positive and negative impacts of the Proposed Project on surface and groundwater during construction, operational and decommissioning phases of the development;
- Identify mitigation measures to avoid, remediate or reduce significant negative impacts; and,
- Assess significant residual impacts, effects and cumulative impacts of the Proposed Project along with other existing or proposed projects including wind farms and infrastructural developments and all others described in Chapter 2 Section 2.5.

Please note that in this chapter we refer to the wind farm (WF) site, and the cable route, and the Proposed Development study area. These identifiers are shown on Plate 10-1. The Proposed Development site Study Area is the Annageeragh–Annagh-Creegh Coastal regional catchment.

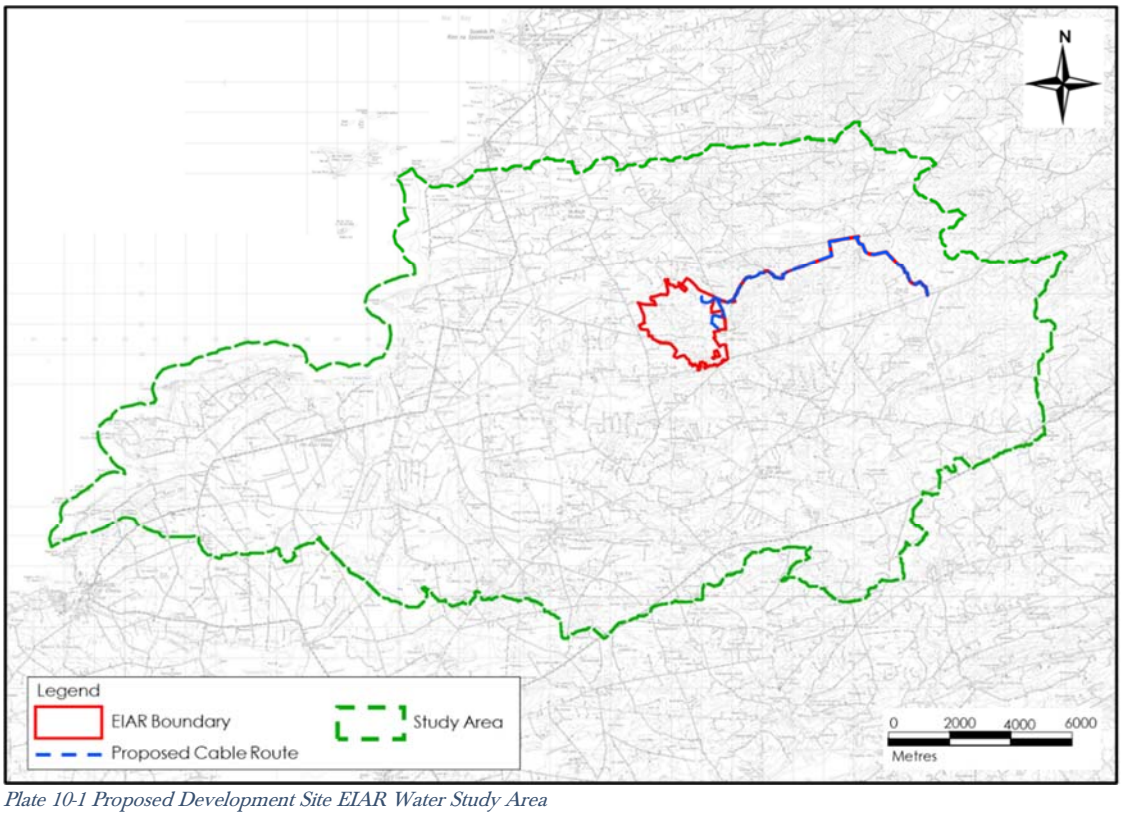


Plate 10-1 Proposed Development Site EIAR Water Study Area

10.1.2 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 David Broderick.

Michael Gill (P. Geo., B.A.I., MSc, Dip. Geol., MIEI) is an Environmental Engineer with over 18 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms in Ireland. He has also managed EIAR 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. For example, Michael has worked on the EIS/EIARs for Slievecallan WF, Cahermurphy (Phase I) WF, and Carrownagowan WF, and over 100 other wind farm related projects across the country.

David Broderick (BSc, H. Dip Env Eng, MSc) is a hydrogeologist with over 13 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 EIARs for a range of commercial developments. David has worked on the EIS/EIARs for Slievecallan WF, Cahermurphy (Phase I) WF, and Oweninny WF, and over 60 other wind farm related projects across the country.

10.1.3 Scoping and Consultation

The scope for this assessment has been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process is outlined in Section 2.6 of this EIAR. Certain issues and concerns highlighted with respect the water environment are summarised in Table 10-1 below.

Table 10-1 Summary of Scoping Responses Relating to Water

Degree/Nature	Response Description	Section of Chapter issue is Addressed
Clare County Council/Department of Culture, Heritage and the Gaeltacht	• The proposed windfarm is located within the Annageeragh and Creegh catchments as such the EIAR should take into consideration the potential for impacts on water quality and substrate conditions in the context of the presence of freshwater pearl mussels within the Annageeragh and Creegh Margaritifera sensitive areas. This	Sections 10.4.3.2 and 10.4.3.11 Sections 10.3 and 10.4

Degree/Nature	Response Description	Section of Chapter issue is Addressed
	refers predominately to the Annageeragh catchment as it has been shown to have some suitable substrate and records of adult mussels in a recent study undertaken by EirEco in 2016. It is highly likely given the results of the 2016 survey the species can be considered effectively extinct in the Creegh catchment owing to severe historical and ongoing drainage along most of its channel. • All Stages of the development should be considered in compiling information regarding the interactions of the development with surface water and groundwater. Impacts on downstream receptors shall be identified.	

10.1.4 Relevant Legislation

The EIAR is prepared in accordance with the requirements of European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the 'EIA Directive') as amended by Directive 2014/52/EU.

Regard has also been taken of the requirements of the following legislation (where Relevant):

- Planning and Development Act 2000 (as amended);
- Planning and Development Regulations, 2001 (as amended);
- S.I. No 296 of 2018: European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 which transposes the provisions of the EIA Directive as amended by the Directive 2014/52/EU into Irish Law;
- S.I. No. 94 of 1997: European Communities (Natural Habitats) Regulations, resulting from EU Directives 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and 79/409/EEC on the conservation of wild birds (the Birds Directive);
- S.I. No. 293 of 1988: Quality of Salmon Water Regulations;
- 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 which implement EU Water Framework Directive (2000/60/EC) and provide for implementation of 'daughter' Groundwater Directive (2006/118/EC). Since 2000 water management in the EU has been directed by the Water Framework Directive (WFD). The key objectives of the WFD are that all water bodies in member states achieve (or retain) at least 'good' status by 2015. Water bodies comprise both surface and groundwater bodies, and the achievement of 'good' status for these depends also on the achievement of 'good' status by dependent ecosystems. Phases of characterisation, risk assessment, monitoring and the design of programmes of measures to achieve the objectives of the WFD have either been completed or are ongoing. In 2015 it replaced a number of existing water related directives, which are successively being repealed, while

implementation of other Directives (such as the Habitats Directive 92/43/EEC) will form part of the achievement of implementation of the objectives of the WFD;
- S.I. No. 41 of 1999: Protection of Groundwater Regulations, 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. 294 of 1989: Quality of Surface Water Intended for Abstraction (Drinking Water), resulting from EU Directive 74/440/EEC concerning the quality required of surface water intended for the abstraction of drinking water in the Member States (repealed by 2000/60/EC in 2007);
- S.I. No. 439 of 2000: European Communities (Drinking Water) Regulations and S.I. No. 278 of 2007 European Communities (Drinking Water No. 2) Regulations, arising from EU Directive 98/83/EC on the quality of water intended for human consumption (the Drinking Water Directive) and WFD 2000/60/EC (the Water Framework Directive);
- S.I. No. 9 of 2010: European Communities Environmental Objectives (Groundwater) Regulations 2010; and,
- S.I. No. 296 of 2009: European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009.

10.1.5 Relevant Guidance

The water section of the EIAR is carried out in accordance with guidance contained in the following:

- Environmental Protection Agency (2017): Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- Environmental Protection Agency (September 2015): Draft - Advice Notes on Current Practice (in the preparation on Environmental Impact Statements) where relevant;
- Environmental Protection Agency (September 2015): Draft – Revised Guidelines on the Information to be Contained in Environmental Impact Statements where relevant;
- Environmental Protection Agency (2003): Advice Notes on Current Practice (in the preparation of Environmental Impact Statements) where relevant;
- Environmental Protection Agency (2006): Environmental Management in the Extractive Industry;
- European Commission (2017): Environmental Impact Assessment of Projects – Guidance on the Preparation of the Environmetal Impact Assessment Report;
- 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;
- Forestry Commission (2004): Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh;
- Coillte (2009): Forest Operations & Water Protection Guidelines;
- Forest Services (Draft) Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures;
- Forest Service (2000): Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford;
- COFORD (2004): Forest Road Manual – Guidelines for the Design, Construction and Management of Forest Roads;
- Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Watercourses;
- Good Practice During Wind Farm Construction (Scottish Natural Heritage, 2010);
- 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); and,
- CIRIA 2006: Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2006.

10.2 Methodology

10.2.1 Desk Study & Preliminary Hydrological Assessment

A desk study of the site and the surrounding area was completed in advance of undertaking the walkover survey. This involved collecting all relevant geological, hydrological, hydrogeological and meteorological data for the area. This included consultation with the following:

- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks & 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 17 (Geology of Shannon Estuary Bay). Geological Survey of Ireland (GSI, 2003);
- Geological Survey of Ireland (2004) – Milltown Malbay Groundwater Body 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).

10.2.2 Site Investigations

Hydrological baseline monitoring, drainage mapping and sampling was undertaken by HES between September and November 2019. Site investigations to address the Water Section of the EIAR included the following:

- Walkover surveys and hydrological mapping of the wind farm site, including the cable route and the study area were undertaken whereby water flow directions and drainage patterns were recorded;
- A total of over 290 no. peat probes were undertaken by Fehily Timoney and Company (FTC) & MKO, to determine the thickness and geomorphology of the blanket peat overlying the wind farm site and cable route;
- A Geotechnical Peat Stability Assessment was undertaken by FTC (December 2019);
- A total of 14 no. trial pits were carried out by Irish Drilling Ltd (IDL) to investigate ground conditions and depth to bedrock at the wind farm site;
- Field hydrochemistry measurements (electrical conductivity, pH, dissolved oxygen and temperature) were taken to determine the origin and nature of surface water flows; and,
- Surface water sampling were undertaken to determine the baseline water quality of the primary surface waters originating from the wind farm site.

10.2.3 Impact Assessment Methodology

Please refer to Chapter 1 of the EIAR for details on the impact assessment methodology (EPA, 2002, 2003, 2015 and 2017). 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 10-2 are then used to assess the potential effect that the Proposed Development may have on them.

Table 10-2 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

10.2.4 Limitations and Difficulties Encountered

No limitations or difficulties were encountered during the preparation of the Water Chapter of the EIAR.

10.3 Receiving Environment

10.3.1 General Site Description

The Proposed Development site is located approximately 4km to the northeast of Creegh, Co. Clare. The permitted Cahermurphy Phase I Windfarm is located immediately to the east of the site. The Proposed Development Study Area is the Annageeragh–Annagh-Creegh Coastal regional catchment.

The proposed wind farm site has an area of ~538 ha. The elevation of the site ranges between 90 – 150m OD (Ordnance Datum). The proposed windfarm infrastructure is located across an east – west ridge which slopes to the north, south and west. The majority of the ridge slopes steadily in a south-westerly direction from the topographic high point which exists on the east of the wind farm site. The northern part of the ridge slopes more steeply to the northwest. The low-lying lands to the north and south of the ridge are gently sloping and undulating.

The wind farm site mainly comprises forestry planted on blanket bog with some poorly draining agricultural land on the east of the wind farm site. The wind farm site is accessible via a number of

existing forestry and farm tracks. A public road separates the proposed wind farm site from the eastern section of Cahermurphy Phase I Windfarm.

Apart from forestry, which is the current predominant land use, the wind farm site is also used for small scale peat cutting and farming.

The grid cable route connection will comprise of an underground cable to the existing Booltiagh 110kV substation with a length of ~12.1km. The cable route to the Booltaigh Substation from either proposed sub-station follows the same route outside the site which mainly comprises underground cabling, measuring approximately 12.1 km in total, located on existing forestry and agricultural land and within the public road corridor.

The replanting lands (34.11ha) are located in counties Roscommon, Clare, Galway and Cavan. The baseline environment, potential direct, indirect and cumulative impacts of replanting lands on the water environment has been assessed in the Section 7 of Appendix 4-3 Assessment of Forestry Replacement Lands.

The hen harrier enhancement area is approximately 1.5 kilometres from the hen harrier territory at Doo Lough. The area is currently dominated by commercial forestry and contains crags with remnant stands of heather.

10.3.2 Water Balance

Long term rainfall and evaporation data was sourced from Met Éireann. The 30-year standard annual average rainfall (SAAR) (1981 - 2010) recorded at Inagh (Mount Callan), approximately 10.5 kilometres northeast of the site, are presented in Table 10-3. This is the most appropriate station to use with respect distance and elevation.

Table 10-3 : Local Average long-term Rainfall Data (mm)

Station		X-Coord		Y-Coord		Ht (mAOD)		Opened		Closed		
Mount Callan		122200		166500		81		1953		-		
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
178.4	128.6	139	90.9	103.8	106.3	116.7	150.8	145	186.7	176.8	180.3	1703

The closest synoptic[1] station where the average potential evapotranspiration (PE) is recorded is at Shannon Airport, approximately 30 kilometres southeast of the site. The long-term average PE for this station is 540mm/yr. This value is used as a best estimate of the site PE. Actual Evaporation (AE) at the site is estimated as 513mm/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:

$$\text{Effective rainfall (ER)} = \text{AAR} - \text{AE}$$

$$= 1{,}703\text{mm/yr} - 513\text{mm/yr}$$

$$\text{ER} = 1{,}190\text{mm/yr}$$

[1] Meteorological station at which observations are made for synoptic meteorology and at the standard synoptic hours of 00:00, 06:00, 12:00, and 18:00.

Based on recharge coefficient estimates from the GSI (www.gsi.ie), an estimate of 5% recharge is taken for the site as an overall average. This value is for "Peat" with a "High" vulnerability rating. Areas where peat is absent may have slightly higher recharge rates, but on this site, these areas are generally on sloping ground and poorly draining. The high stream density in the area would also suggest that recharge rates are very low.

The lowest value in the available range was chosen to reflect the large coverage of blanket peat and high drainage density. Therefore, annual recharge and runoff rates for the site are estimated to be 59mm/yr and 1,131mm/yr respectively.

Table 10-4 presents return period rainfall depths for the centre of the wind farm site. These data are taken from https://www.met.ie/climate/services/rainfall-return-periods and they provide rainfall depths for various storm durations and sample return periods (1-year, 50-year, 100-year).

Table 10-4 : Return Period Rainfall Depths for Cahermurphy Two WF site (mm)

Duration	10-year Return Period	50-Year Return Period	100-Year Return Period
15 min	14.2	22.0	26.4
1 hour	22.7	32.6	38.3
6 hour	39.7	54.4	62
12 hour	49.7	66.3	74.8
24 hour	62.3	80.9	90.1
48 hour	77.2	97.7	107.7

10.3.3 Regional Hydrology

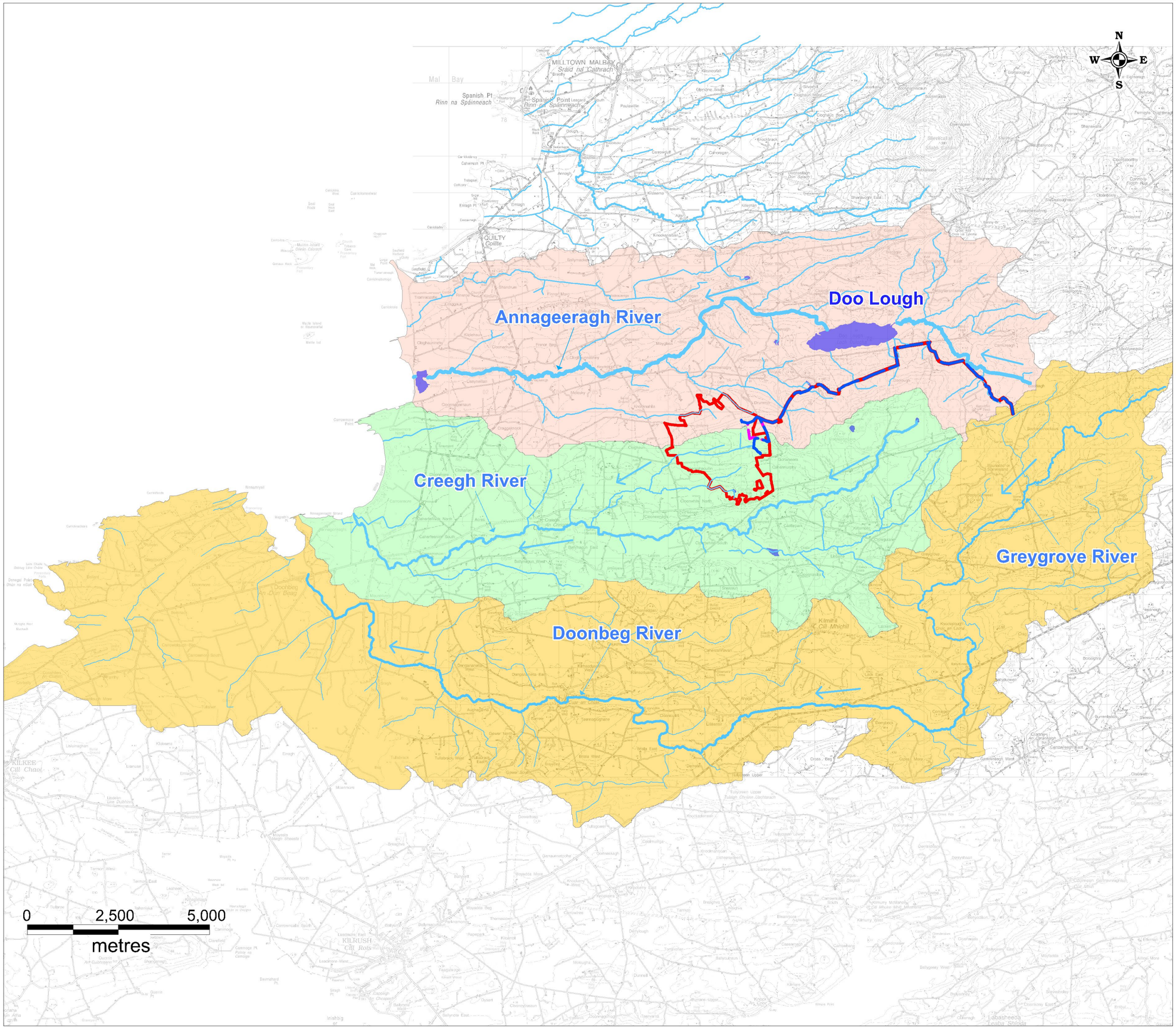
Regionally the proposed wind farm site and grid connection (including the hen harrier enhancement lands and haul route works) are located in the Annageeragh–Annagh-Creegh Coastal regional catchment within Hydrometric Area 28 of the Shannon River Basin District. The grid connection is located in the Annageeragh–Annagh-Creegh Coastal catchment and the Doonbeg River regional catchment). A regional hydrology map is shown as Figure 10.1.

On a local scale the northern section of the site (3 no. of 10 turbines) is located within the Annageeragh River catchment (Annageeragh_SC_010) while the southern section of the site (7 no. of 10 turbines) is located within the Creegh River catchment (Kiltumperstream_SC_010). The Annageeragh River originates from Doo Lough which is located approximately 2.6km to the northeast of the wind farm site. There is no wind farm drainage into Doo Lough, however sections of the grid connection drain into Doo Lough as described below.

The majority of the cable route is located in the Annageeragh River catchment (~180m of the grid near the Booltiagh WF Substation extends into the Doonbeg River catchment (Doonbeg_SC_010).

Within the Annageeragh River catchment, approximately 6.5km of the grid route drains into Doo Lough.

A summary of the proposed infrastructure with respect the regional and local hydrology is shown in Table 10-5 below. A local hydrology map is shown as Figure 10.2.



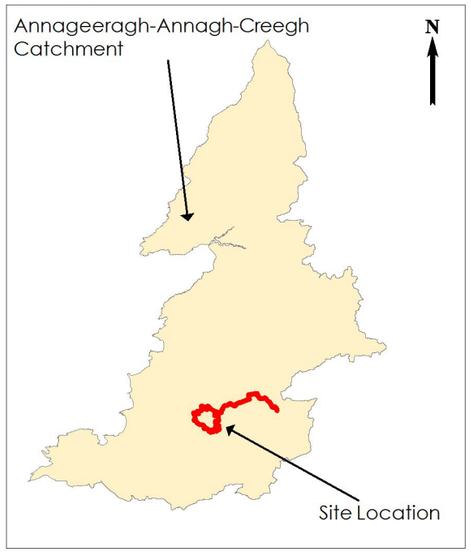
Legend

- EIAR Site Boundary
- Proposed Cable Route
- Proposed Alternative Cable Route
- Rivers
- Lake

WFD Subcatchments

- Annageeragh River Catchment
- Doonbeg River Catchment
- Creegh River Catchment

KEY PLAN



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Job: Cahermurphy WF, Co. Clare	
Title: Regional Hydrology Map	
Figure No: 10-1	
Drawing No: P1477-0-0720-A3-10-1-0A	
Sheet Size: A3	Project No: P1477-0
Scale: 1:60,000	Drawn By: GD
Date: 14/07/2020	Checked By: MG

Legend

- Site Boundary
- Proposed Turbine Layout
- Proposed Cable Route
- Proposed Alternative Cable Route
- Rivers
- Lake
- Grid Connection
  Watercourse Crossing Locations

T1 T2 T3 T4 T5 T6 T7 T8 T9 T10

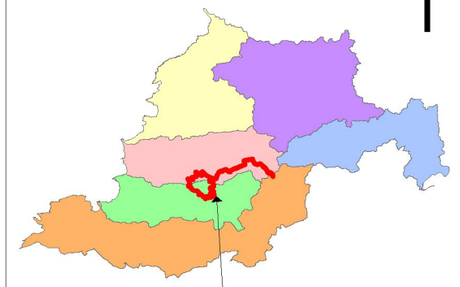
1 2 3 4 5 6 7 8 9

0 1,250 2,500 meters

Subcatchments Legend

- Annageeragh_SC_010 (Annageeragh River)
- Annagh[Clare]_SC_010 (Annagh [Clare] River)
- Doonbeg_SC_010 (Doonbeg River)
- Fergus_SC_050 (Inch [Clare] River)
- Inagh[Ennistymon]_SC_010 (Inagh [Ennistymon] River)
- KiltumperStream_SC_010 (Creegh River)

KEY PLAN



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Client: MKO	
Job: Cahermurphy WF, Co. Clare	
Title: Local Hydrology Map	
Figure No: 10-2	
Drawing No: P1477-0-0720-A3-10-2-0A	
Sheet Size: A3	Project No: P1477-0
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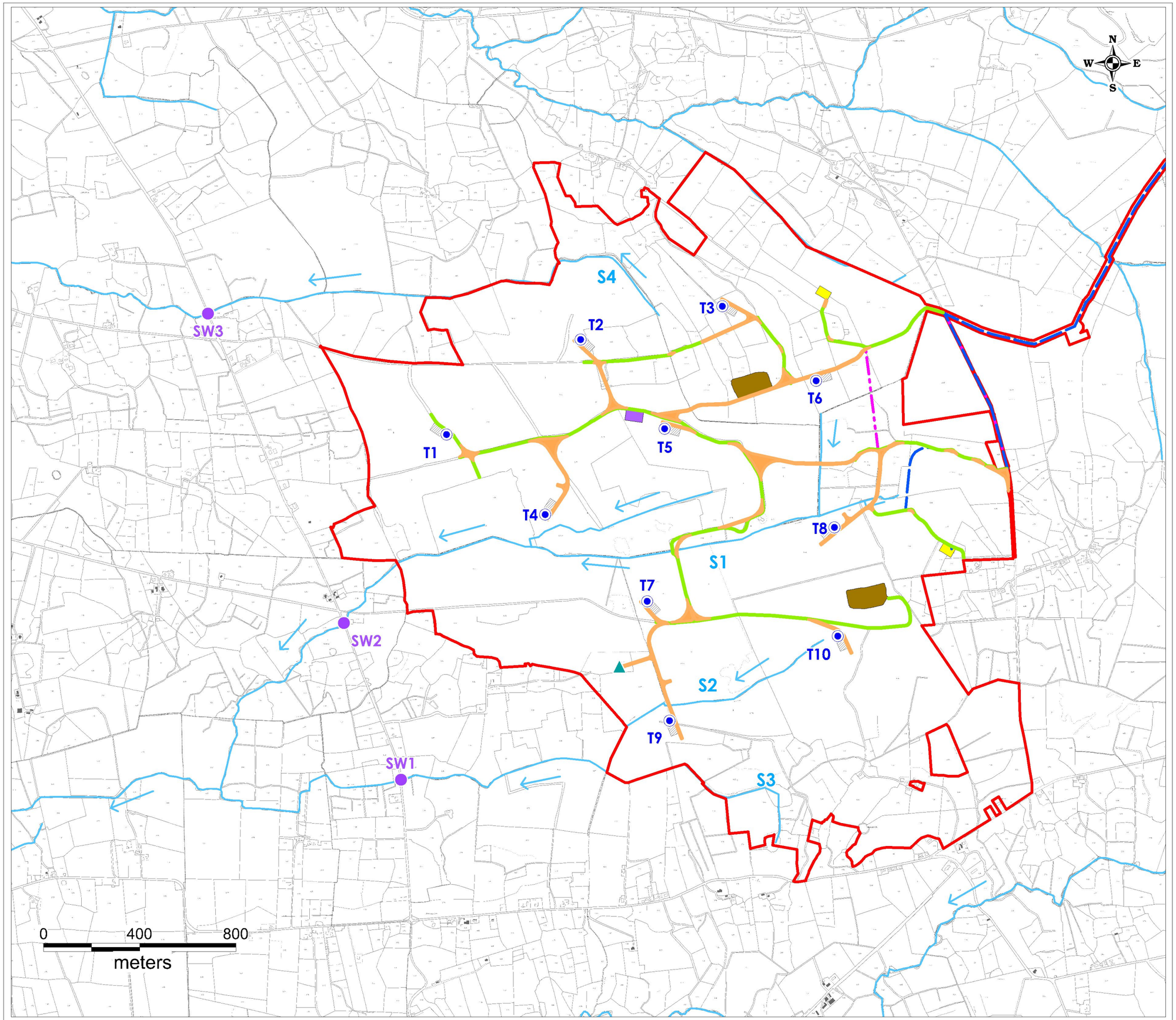
Date: 15/07/2020	Checked By: MG



Legend

- EIAR Site Boundary
- Proposed Turbine Layout
- Proposed Met Mast
- Proposed Electricity Substation Compound
- Proposed Borrow Pit
- Proposed Construction Compound
- Existing Road to be Upgraded
- Proposed New Road
- Proposed Hardstanding
- Proposed Cable Route
- Proposed Alternative Cable Route
- SW Sampling Location
- S1 - S4 Stream numbers

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Client: MKO	
Job: Cahermurphy WF, Co. Clare	
Title: Wind Farm Site Drainage Map	
Figure No: 10-3	
Drawing No: P1477-0-0720-A3-10-3-0A	
Sheet Size: A3	Project No: P1477-0
Scale: 1:15,000	Drawn By: GD
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10.3.4 Windfarm and Cable Route Drainage

The majority of the wind farm site drains in a south-westerly direction towards the Creegh River which is located approximately 3.5km downstream (south) of the site. There are three main first order streams which emerge from the southern section of the wind farm site and flow towards the Creegh River. Stream S1 flows through the main central catchment area of the wind farm site in which proposed turbine locations T4, T5, T7 and T8 are located (refer to Figure 10.3). The two smaller streams (S2 and S3) rise from the southern section of the wind farm site and merge at the southwestern boundary prior to flowing towards the Creegh River. Proposed turbines T9 and T10 are located in the catchment area of S2. Stream S3 originates from a small lake located in the southwestern corner of the wind farm site. There is no windfarm development in stream S3 catchment. Refer to Table 10-5 below with respect the proposed infrastructure and on-site (wind farm) drainage.

The northern section of the wind farm site, which includes turbine locations T1, T2 and T3, is drained by a headwater stream (S4) of the Annageeragh River. Stream S4 emerges from a forested area between turbine locations T2 and T3. A wind farm site drainage map for the windfarm is shown as Figure 10.3.

As discussed above, the majority of the cable route is located in the Annageeragh River catchment.

Also, within the Annageeragh River catchment, the majority of the cable route is upstream of Doo Lough (from which the Annageeragh River originates). Along the cable route there are a total of 9 no. watercourse crossings and all are located in the Annageeragh River catchment. with 7 no. of these draining directly into Doo Lough mainly first/second order streams along with drains.

The locations of the proposed watercourse crossings along the cable route are shown on Figure 10.2.

Within the wind farm site, and along forested sections of the cable route, there are numerous manmade drains that are in place predominately to drain the forestry plantations. The current internal forestry drainage pattern is influenced by the topography, peat subsoils, layout of the forest plantation and by the existing road network. The forest plantations, which cover ~59% of the wind farm site (where clear felling has occurred forests drains still exist as before, and replanting has generally taken place) are generally drained by a network of mound drains or plough ribbons which typically run perpendicular to the topographic contours of the site and feed into collector drains, which discharge to interceptor drains down-gradient of the plantation.

Mound drains and ploughed ribbon drains are generally spaced approximately every 15m and 2m respectively. As illustrated in Plate 10-2, interceptor drains are generally located up-gradient (cut-off drains) and down-gradient of forestry plantations. Interceptor drains are also located up-gradient of forestry access roads. Culverts are generally located at stream crossings and at low points under access roads which drain runoff onto down-gradient forest plantations. A schematic of a typical standard forestry drainage network and one which is representative of the site drainage network is shown as Plate 10-2.

The forestry drains are the primary existing drainage routes towards the natural streams on the wind farm and cable route sites, but the flows in these drains are generally very low. The integration of the existing main drains with the proposed wind farm drainage is a key component of the wind farm drainage design which is discussed further in Section 10.4.1 below.

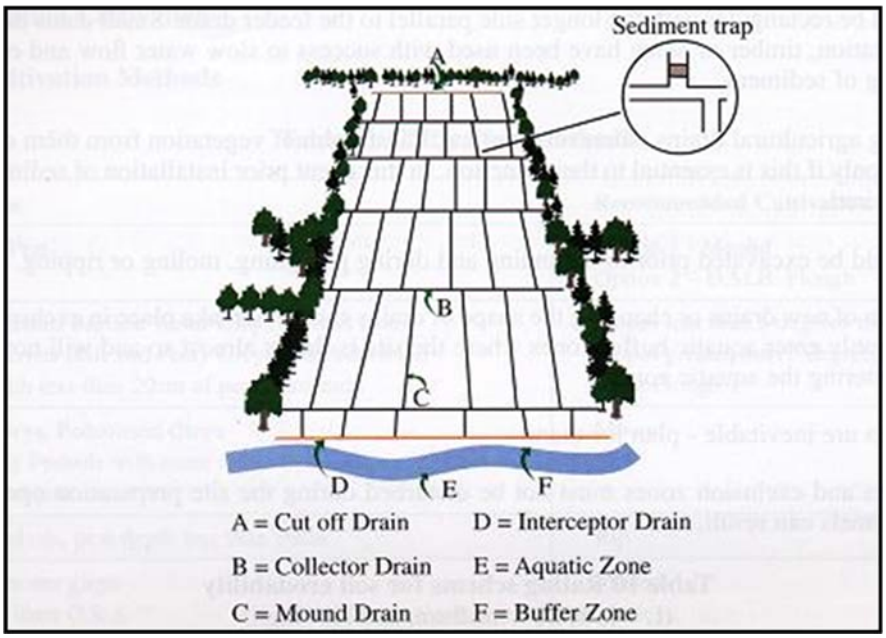


Plate 10-2 Typical Forestry Drainage

A summary of the sub-catchments along with relevant Proposed Development infrastructure and significant existing drainage features/routes are shown in Table 10-5.

Table 10-5 : Summary of Site Sub-catchments & Proposed Infrastructure

Main River (EPA Sub-catchment Name)	Main Development Infrastructure	Primary Wind Farm On-site Drainage Features
Annageeragh River (Annagh[Clare]_SC_010)	3 no. turbines, substation (option 2), borrow pit 2, entire cable route (bar last ~180m)	Stream S4
Creegh River (Kiltumper Stream_SC_010)	7 no. turbines, substation (option 1), borrow pit 2, met mast and construction compound	Streams S1 – S3
Doonbeg River (Doonbeg_SC_010)	~180m of grid	n/a

10.3.1 Baseline Assessment of Windfarm 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 (ie. wind farm site).

The rainfall depths used in this water balance, are long term averages and 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 10-6). 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 95% based on the predominant peat coverage at the site and low permeability bedrock.

The highest long-term average monthly rainfall recorded at Inagh Rainfall Station over 30 years occurred in the month of December, at 175mm. The average monthly evapotranspiration for the synoptic station at Shannon Airport over the same period in December was 3.1mm. The water balance presented in Table 10-7 indicates that a conservative estimate of surface water runoff for the site during the highest rainfall month is 817,000m^3/month or 26,355m^3/day for the wind farm site.

The 1 in 100-year 6-hour return period will be used for drainage design purposes.

Table 10-6 Water Balance and Baseline Runoff Estimates for Wettest Month (December)

Water Balance Component	Depth (m)
Average December Rainfall (R)	0.175
Average December Potential Evapotranspiration (PE)	0.0031
Average December Actual Evapotranspiration (AE = PE x 0.95)	0.00295
Effective Rainfall December (ER = R - AE)	0.172
Recharge (5% of ER)	0.01
Runoff (95% of ER)	0.163

Table 10-7: Baseline Runoff for the Windfarm Site

Approx. Area (ha)	Baseline Runoff per month (m^3)	Baseline Runoff per day (m^3)
500	817,000	26,355

10.3.2 Flood Risk Identification

OPW's Flood Hazard Mapping (www.floodmaps.ie), CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie), Department of Environment, Community and Local Government on-line planning mapping (www.myplan.ie) and historical mapping (i.e. 6" & 25" base maps) were consulted to identify those areas as being at risk of flooding.

No recurring flood incidents within the EIAR site boundary were identified from OPW's Flood Hazard Mapping (refer to Plate 10-3). The closest mapped recurring flood event is 5km downstream of the site on the Annageeragh River. There is also a recurring flood event mapped 6km downstream of the site on the Creegh River.

The PFRA mapping (shown as Plate 10-4 below) shows the extents of the indicative 100-year flood zone which relates to fluvial (i.e. river) and pluvial (i.e. rainfall) flood events. The 100-year fluvial flood zones mapped within the site occurs along Stream S1 which is the main watercourses draining the southern section of the site.

All proposed turbine locations, substation, construction compounds, met mast, borrow pits and access roads (with the exception of stream crossings and road upgrades) are located at least 50m away from streams and are outside of the fluvial indicative 100-year flood zone.

There is no text on local available historical 6" or 25" mapping for the proposed site that identify areas that are "prone to flooding" within the Proposed Development site.

It is a key design of the proposed wind farm development to ensure all surface water runoff is treated (water quality control) and attenuated (water quantity control) prior to diffuse discharge at pre-existing Greenfield rates. As such the mechanism by which downstream flooding is prevented and controlled is through avoidance by design. These proposed drainage attenuation measures are outlined in the impact assessment section below.

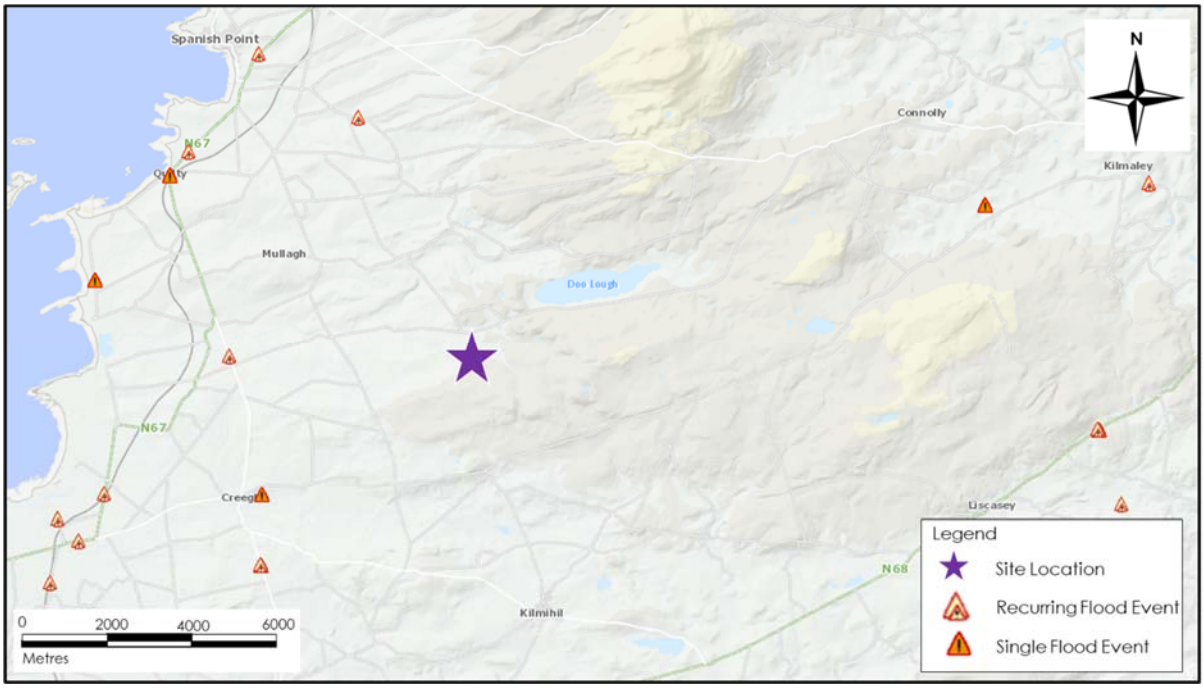


Plate 10-3 OPW Flood Hazard Map

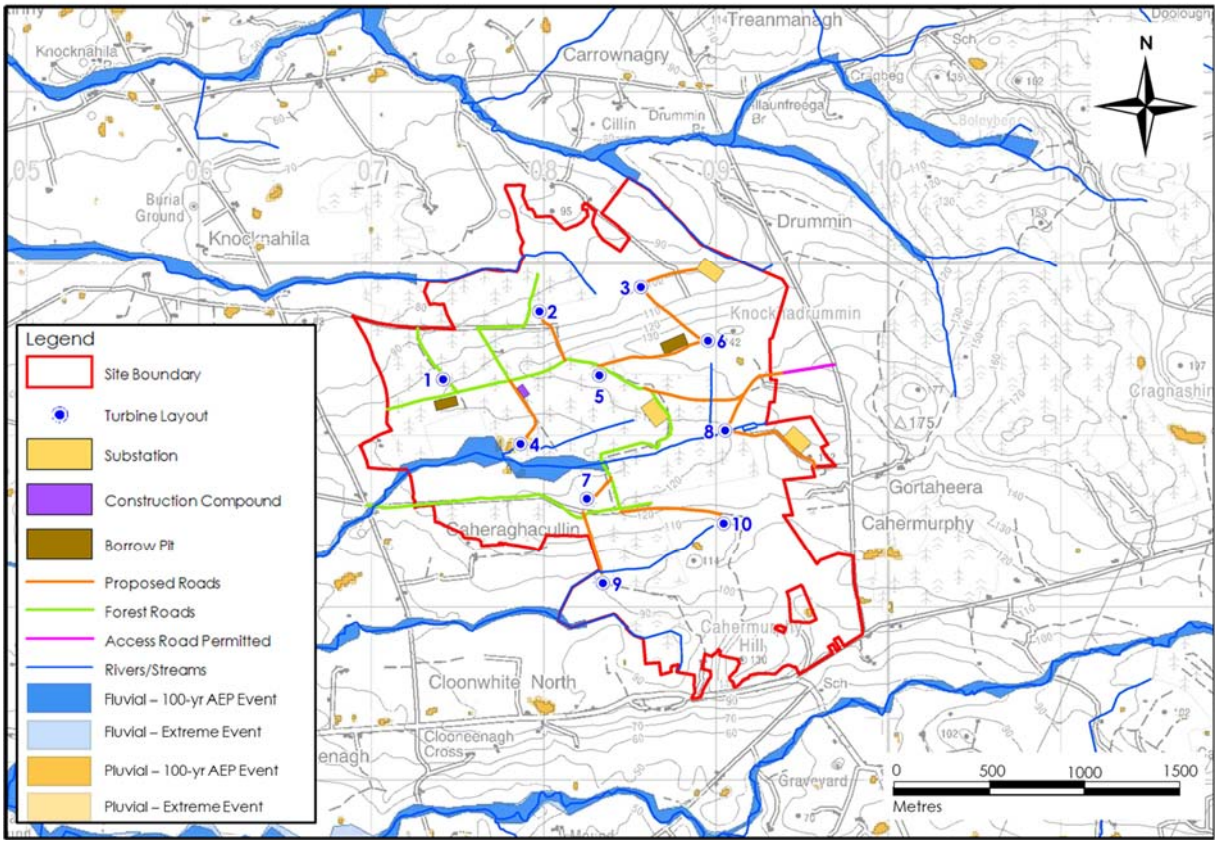


Plate 10-4 PFRA Flood Map

10.3.3 Surface Water Hydrochemistry

Q-rating data is available for the Annageeragh River (at Knocknahilla Bridge) approximately 5km downstream of the site. Q values (Q1-Q5) are a classification system given to waterbodies, determined by the EPA, which relate to their biotic and chemical condition. A high value (Q4-5) indicates a high status, unpolluted waterbody.

Most recent EPA data (https://www.catchments.ie/data) (2018) indicate a Q rating of 4 (Good Status). Doo Lough was assigned a Moderate ecological status in 2009 (most recent assessment).

Q-rating data is available for the Creegh River (Bridge at Creegh) approximately 6km downstream of the site. Most recent data (2018) indicate a Q rating of 4 (Good Status). The Doonbeg River downstream of the proposed cable route was also assigned a Q4 rating 2018.

Field hydrochemistry measurements of unstable parameters, electrical conductivity (µS/cm), pH (pH units) and temperature (°C) were taken at the surface water sampling locations SW1, SW2 and SW3 on 11th September 2019 and these data are presented in Table 10-8 below. These locations are on the main watercourses draining the site. All measurements were undertaken in natural streams as many drains were dry.

Electrical conductivity values for the local streams ranged between 160µS/cm and 180µS/cm. pH values which were all slightly basic ranged from 7.0 to 7.7. The measurements were taken during a dry spell and the recorded measurements will be more characteristic of baseflow hydrochemistry (i.e. groundwater baseflow being the primary component of the stream discharge). During wetter periods electrical conductivity values are likely to be lower due to runoff from the bog surface.

Grab sampling was also completed on 11th September 2019 and the laboratory results are shown below in Table 10-9 alongside relevant Environmental Quality Standards (EQS) values for surface water. The locations of the sampling points are shown on Figure 10.3. Laboratory reports are attached as Appendix 10-1.

Table 10-8 : Summary of Surface Water Chemistry Measurements

Location	EC (µS/cm)	pH	Temperature (°C)
SW1	180	7.7	8.5
SW2	160	7.3	8.9
SW3	158	7.0	8.9

Table 10-9 : Analytical Results of Surface Water Samples

Parameter	EQS	Sample ID		
		SW1	SW2	SW3
Total Suspended Solids (mg/L)	25(+)	6	7	7
Ammonia (mg/L)	Good Status: ≤0.065 High Status ≤ 0.04(*)	0.05	0.03	0.02
Nitrite NO_2 (mg/L)	-	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	Good Status ≤ 0.035 to High Status: ≤0.025(*)	0.03	0.02	0.02
Nitrate - NO_3 (mg/L)	-	<5	<5	<5
Nitrogen (mg/L)	-	<1.0	<1.0	<1
Phosphorus (mg/L)	-	0.1	<0.1	0.1
Chloride (mg/L)	-	29.2	23.8	43.9
BOD	Good Status: ≤ 1.5 High Status: ≤ 1.3(*)	2	3	9

(+) S.I. No. 293 of 1988: Quality of Salmon Water 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.

Total suspended solids ranged between 6 – 7mg/L which is well below the standard set out in S.I. 293 of 1988.

Results for nitrate, nitrite, nitrogen and phosphorus were at or below the detection limit of the laboratory. Ammonia ranged between 0.02 and 0.05mg/L with SW2 and SW3 being below the "High Status" threshold and SW1 being below the "Good Status" threshold with respect the Surface Water Regulations (S.I. 272 of 2009).

In similar trend to ammonia, Orthophosphate ranged between 0.02 and 0.03mg/L with SW2 and SW3 being below the "High Status" threshold and SW1 being below the "Good Status" threshold.

The baseline Biological Oxygen Demand (BOD) was reported as between 2 and 9mg/L and therefore exceeded the Surface Water Regulations threshold values (S.I. 272 of 2009) for Good and High status (refer to Table 10-9). The proposed development has no potential to increase BOD levels in surface waters.

10.3.4 Hydrogeology

The rocks of the Gull Island Formation, which underlie the site are classified by the GSI (www.gsi.ie) as a Locally Important Aquifer, having bedrock which is generally unproductive except for local zones (Ll).

The Namurian rocks of the Gull Island Formation which comprises sequences of siltstone and sandstone are generally devoid of inter-granular permeability. Groundwater flow occurs only in fractures, joints and faults, except for the top few metres of the rock where the rocks are likely to be more fractured and/ or weathered.

Bedrock fissures are generally poorly connected, with fissure permeability reducing rapidly with depth (GSI, 2004). Most flow is therefore expected to occur in the top 5 to 15m of the bedrock. Due to the low subsoil permeability, and low infiltration rates, a high proportion of the rainwater will leave the site as surface runoff. Where groundwater flow does occur, it is normally relatively shallow and closely linked to surface waters due to short flow paths (30 – 300m).

Baseflow contribution to streams tends to be low, particularly in summer as the groundwater regime cannot sustain summer baseflows due to low storativity with the aquifer. In winter, low permeabilities will lead to a high water table and potential water logging of soils which is consistent with the mapped soil type in the vicinity of streams (i.e. poorly drained mineral & peaty soil). Local groundwater flow directions will generally mimic topography whereby flow paths will be from topographic high points to lower elevated discharge areas at local streams.

Groundwater was noted during the excavation of eight of the trial pits (TP-SS02, TP02, TP03, TP04, TP07, TP08, TP09 and TP10). The inflows were mainly from the gravel layers and were mainly minor volumes. The inflows were typically between 1.9 and 4.5m below ground level.

10.3.5 Groundwater Vulnerability

The vulnerability of the aquifer underlying the site is classified as ranging between Moderate to Extreme (X) with most of the proposed windfarm infrastructure located in area mapped as High to Extreme (X) vulnerability. The higher the groundwater vulnerability rating is a reflection of how close bedrock is to the ground surface.

This suggests that blanket peat and mineral subsoils, which overlies the proposed development areas, has a thickness of between 0 and 5m which is relatively consistent with the trial pit investigation results (refer to Chapter 9 – Land, Soils and Geology).

The groundwater vulnerability rating along the proposed grid connection options have a similar rating (i.e. Moderate to Extreme).

However, due to the low permeability nature of the bedrock aquifer underlying the site, groundwater flow paths are likely to be short, with recharge emerging close by at seeps and surface streams. This means there is a low potential for groundwater dispersion and movement within the aquifer, therefore making surface water bodies such as drains and streams more vulnerable than groundwater at this site.

10.3.6 Groundwater Hydrochemistry

Namurian bedrock aquifers (including the Gull Island Formation) have predominantly Calcium Bicarbonate (Ca-HCO_3) hydrochemical signatures. These signatures vary from 'fresh' signatures to Magnesium – Sodium/Potassium - Chloride (Mg-Na/K-Cl) signatures indicative of ion exchange and long flow paths and residence times. A Ca-Mg-HCO_3 would be expected for groundwaters close to the recharge area of the aquifer. There is a possibility that due to the proximity to the coast the

Ca-HCO_3 signature may vary towards a K/Na-Cl due to the influence of seawater chemistry on the rainfall that is recharging the aquifer.

10.3.7 Groundwater Body Status

Local Groundwater Body (GWB) status information are available (www.catchments.ie).

The Milltown Malbay GWB (GWB: IE_SH_G_167) underlies the proposed site and extends west as far as the coastline. It is assigned 'Good Status', which is defined based on the quantitative status and chemical status of the GWB.

10.3.8 Surface Water Body Status

Local Surface water Body status and risk result are available from (www.catchments.ie). Also available from www.catchments.ie are the catchment boundaries, as delineated by the Water Framework Directive. These areas are mapped at varying scales. Regional catchments are large scale basins (*i.e* Mal Bay catchment). The regional catchments are broken down into smaller sub-catchments (*i.e* Annageeragh_SC_010). Within these subcatchment, smaller river sub-basins are mapped which are local scale basins (*i.e* Annageeragh_010 and Annageeragh_020 river sub-basins). It should be noted that in some cases the naming of the rivers by the EPA/WFD does not align with OSi Discovery maps and local river naming. An example of this is the KiltumperStream_SC_010 sub-cacthment, which is generally referred to as the Creegh river sub-catchment.

The Proposed Development site (ie. wind farm site and grid connection route)is located within the Annageeragh River, Creegh River and Doonbeg river sub-catchments (See Figure 10.2).

The catchment area (river sub-basin) of the Annageeragh River upstream of Doo Lough is referred to as the Annageeragh_020 and the proposed development in this river sub-basin area is limited to the grid connection. The Annageeragh_020 sub-basin is given a "Poor Status" in terms of water quality. Downstream of Doo Lough (Annageeragh_030), the Annageeragh River is rated as "Good Status" by the WFD 2013-2018.

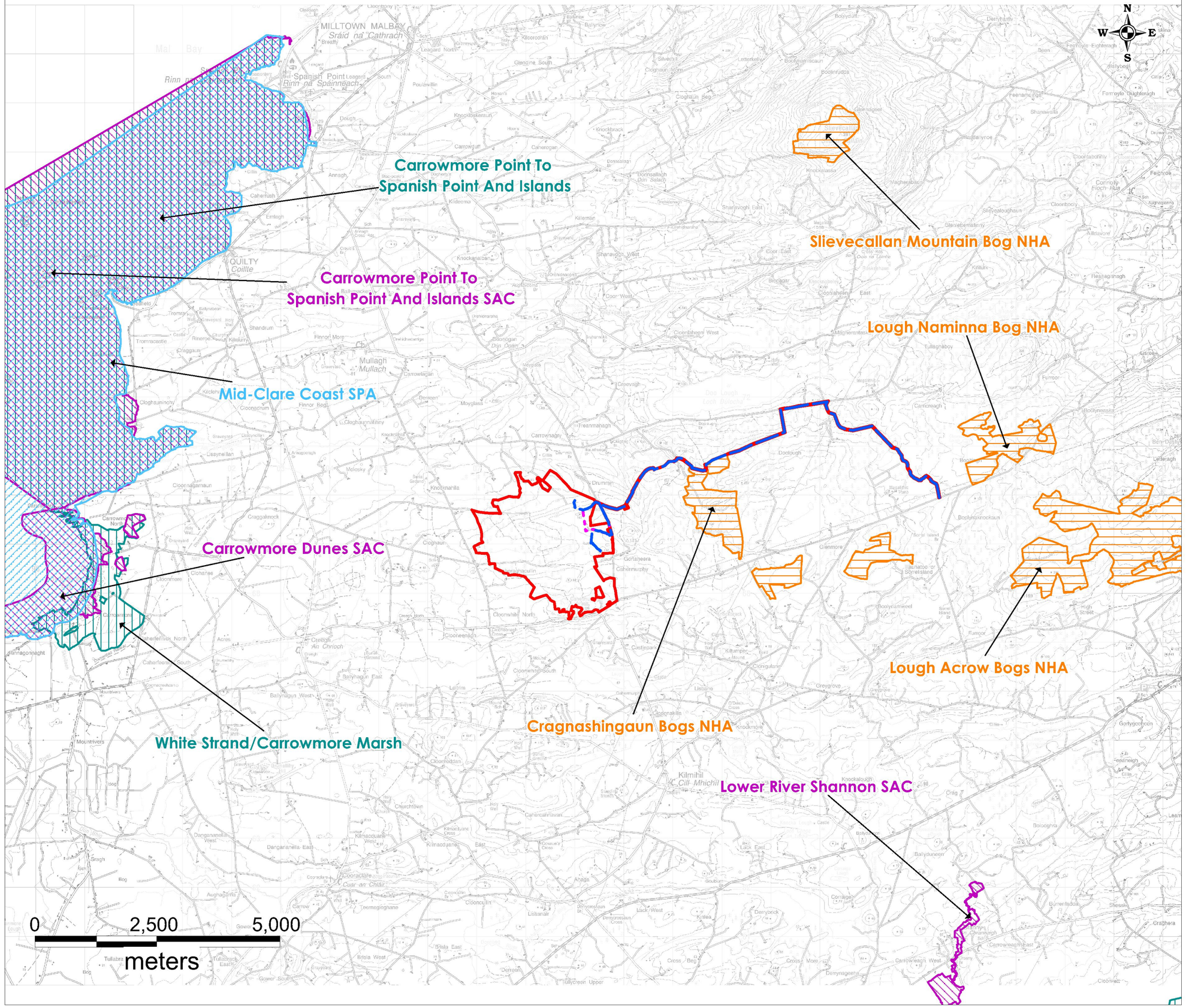
The Creegh River both upstream (Creegh_020) and downstream (Creegh_020 and Creegh_030) is rated as "Good Status". Likewise, the Doonbeg River (Doonbeg_020_CS and Doonbeg_030_SC) downstream of the site is rated as "Good Status" as outlined in the WFD cycle 2013-2018.

10.3.9 Designated Sites & Habitats

Designated sites include National Heritage Areas (NHAs), proposed National Heritage Areas (pNHAs), Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs). The proposed development site is not located within any designated site.

Designated sites downstream of the site include the Mid-Clare Coast SPA (Site Code 004182), Carrowmore Point to Spanish Point and Islands cSAC (Site Code 001021) and White Strand/Carrowmore Marsh pNHA (Site Code 001007). For more details on designated sites refer to the Biodiversity Chapter (Chapter 7).

Local designated sites are shown on Figure 10.4.



Legend

- EIAR Site Boundary
- Proposed Cable Route
- Proposed Alternative Cable Route
- SPA
- SAC
- pNHA
- NHA

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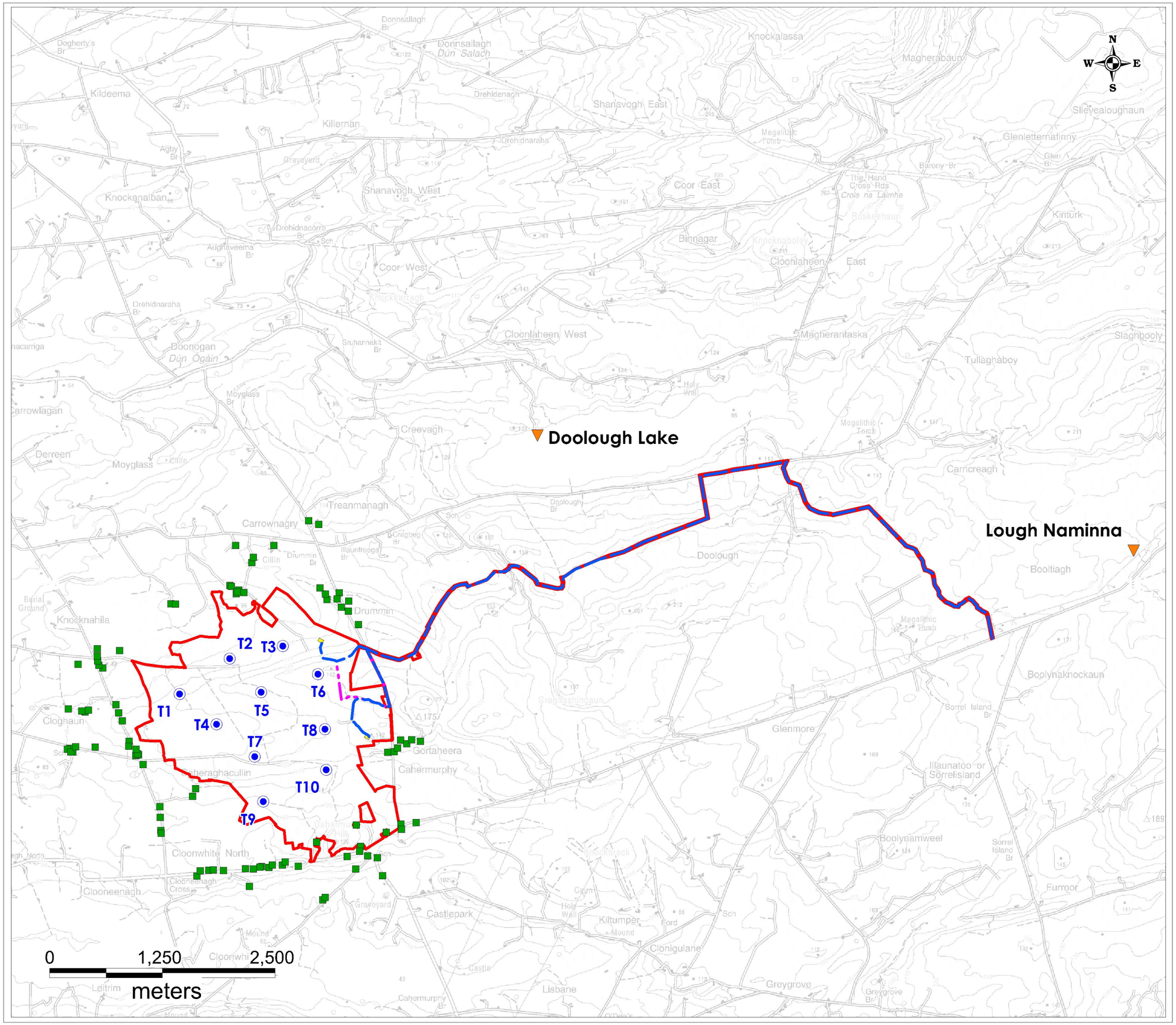

Legend

- EIAR Site Boundary
- Proposed Turbine Layout
- Proposed Cable Route
- Proposed Alternative Cable Route
- Proposed Electricity Substation Compound
- Public Water Supply Surface Water Abstractions
- Private Water Supply

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Job: Cahermurphy WF, Co. Clare	
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10.3.10 Water Resources

Public water supply surface water abstractions in this area include Lough Naminna and Doo Lough. Lough Naminna is located 1.6km to the northeast of the Booltiagh Substation which is the proposed grid connection point. However, the grid connection route is located downstream of Lough Naminna and therefore no impacts will occur.

Doo Lough which is the source of the West Clare Public Water Supply Scheme, is located 2.4km to the northeast of the proposed windfarm site. The proposed windfarm site is not located in the surface water catchment to Doo Lough. However, as described above, sections of the grid connection are located in the catchment to Doo Lough with many of the watercourses crossed by the proposed grid routes draining directly into Doo Lough itself. An impact assessment and proposed mitigation measures with respect Doo Lough are provided below. The surface water catchment of Doo Lough and the public water supply abstraction location are shown on Figure 10.5.

There are no mapped public groundwater supplies or registered group scheme supplies (NFGWS) within 5km of the wind farm site boundary.

A search of the Geological Survey of Ireland (GSI) well database (www.gsi.ie) indicated that there 2 no. wells within 1km of the proposed development site. As the GSI well database is not exhaustive in terms of the locations of all wells in the area (as the database relies on the submission of data by drillers and the public etc) it is assumed that every private dwelling down hydraulic gradient of the proposed development has a water supply well associated with it (this is unlikely to be the case but is a worst case scenario assessment). Shown on Figure 10.5 are the locations of private dwellings within ~300m of the wind farm site boundary.

The majority of these dwellings are very remote to the wind farm site and given the bedrock geology type within the wind farm site and the unproductive nature of the underlying aquifer there will be no hydraulic connection between any potential wells and groundwater flow from the wind farm site.The groundwater flow direction in the aquifer underlying the wind farm site will mimic the topography whereby flow paths will be from topographic high points to lower elevated discharge areas at streams and rivers. As stated above, flow paths are thought to be between 30 – 300m in length and given the fact that all dwelling houses are more 700m away there is a low risk of impact.

Nevertheless, using the conceptual model of groundwater flow mimicking topography, the potential impact of excavations and the borrow pit on down-gradient wells within each sub-catchment is assessed below in Section 10.5.3.10.

10.3.11 Receptor Sensitivity

Groundwater

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 risk to groundwater at the site will be from cementitious materials, hydrocarbon spillage and leakages. These are common potential impacts on all construction sites (such as road works and industrial sites). All potential contamination sources are to be carefully managed at the site during the construction and operational and decommissioning phases of the development and mitigation measures are proposed below to deal with these potential effects.

Based on criteria set out in Table 10-2 groundwater at the site can be classed as Sensitive to pollution because the Gull Island Formation is classified as a Locally Important Aquifer (Ll). However, the majority of the site is covered in peat and silty/clayey subsoils which acts as a protective cover to the underlying aquifer. Any contaminants which may be accidently released on-site will travel to nearby

streams within surface runoff. The low permeability of the bedrock means that any contaminant that may reach the bedrock would not disperse and would remain localised to the source or would be removed as runoff during wet periods.

Surface water

Surface waters such as the downstream Creegh River, Annageeragh River and Doonbeg River can be considered very sensitive to potential contamination. The primary potential contaminant is suspended solids and associated nutrients. These rivers, particularly the Annageeragh River and the Doonbeg River have freshwater pearl mussels present.

The designated sites that are hydraulically connected (surface water flow paths only) to the proposed wind farm development include the Mid-Clare Coast SPA (Site Code 004182), Carrowmore Point to Spanish Point and Islands cSAC (Site Code 001021) and White Strand/Carrowmore Marsh pNHA (Site Code 001007). From a hydrological perspective there will be low risk of impact on these marine designated sites as they are significantly less sensitive (even without mitigation) compared to a freshwater habitat with regard to construction effects.

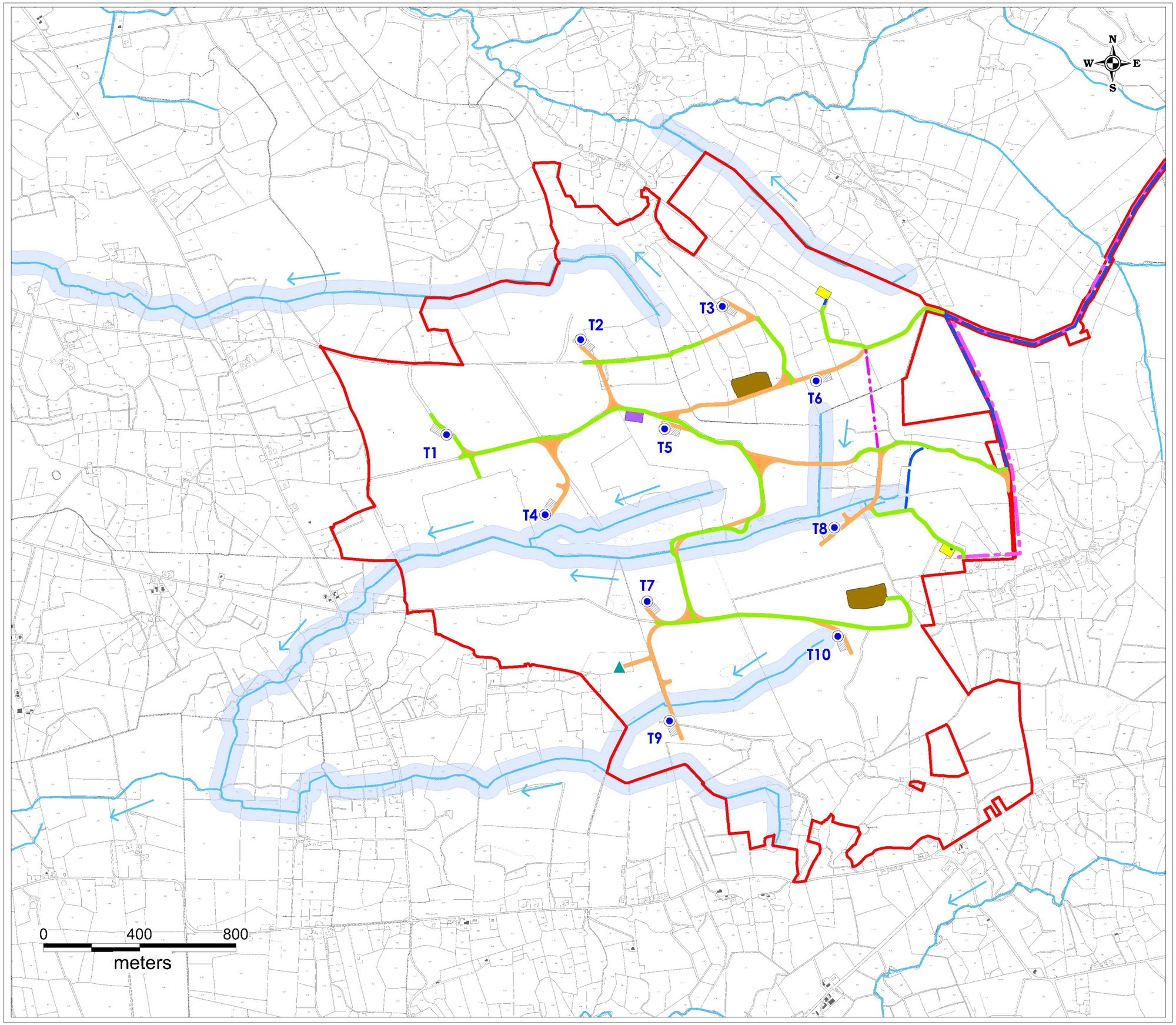
Comprehensive surface water mitigation and controls are outlined below to ensure protection of all downstream receiving waters. Mitigation measures will ensure that surface runoff from the developed areas of the site will be of a high quality and will therefore not impact on the quality of downstream surface water bodies. Any introduced drainage works at the site will mimic the existing hydrological regime thereby avoiding changes to flow volumes leaving the site.

A hydrological constraints map for the site is shown as Figure 10.6. A self-imposed 50m buffer from streams and lakes was applied during the constraints mapping and will be maintained during the construction phase. Apart from the upgrade of sections of the access road network adjacent/proximate to streams and at stream crossings, the proposed infrastructure is away from areas within the wind farm site that have been determined to be hydrologically sensitive. The large setback distance from sensitive hydrological features means they will not be impacted on by excavations/drains etc. It also allows adequate room for the proposed drainage mitigation measures (discussed below) to be properly installed up-gradient of primary drainage features within sub-catchments. This will ensure attenuation of surface runoff to be more effective.

10.4 Characteristics of the Proposed Development

The development comprises of the following:

- 10 no. wind turbines with an overall blade tip height of up to 170 metres and all associated hard-standing areas;
- 1 no. permanent meteorological mast up to a height of 100 metres;
- Provision of new site access roads and upgrade of existing roads and associated drainage;
- 1 no. 38 kV electrical substation at two possible locations:
- 1 no. temporary construction compound;
- All associated underground electrical and communications cabling connecting the turbines to the proposed electrical substation;
- Junction access road works;
- Site drainage;
- 2 no. borrow pits;
- Forestry Felling to facilitate construction and operation of the proposed development;
- All works associated with the connection of the proposed wind farm to the national electricity grid at the existing Booltiagh 110kV substation; and,
- All associated site development works.



Legend

- EIAR Site Boundary
- Proposed Turbine Layout
- Proposed Met Mast
- Proposed Electricity Substation Compound
- Proposed Borrow Pit
- Proposed Construction Compound
- Existing Road to be Upgraded
- Proposed New Road
- Proposed Hardstanding
- Proposed Cable Route
- Proposed Alternative Cable Route
- Rivers
- 50m River Buffer

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Client: MKO	
Job: Cahermurphy WF, Co. Clare	
Title: Hydro-Constraints Map	
Figure No: 10-6	
Drawing No: P1477-0-0720-A3-10-6-0A	
Sheet Size: A3	Project No: P1477-0
Scale: 1:15,000	Drawn By: GD
Date: 14/07/2020	Checked By: MG

10.4.1 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 wind farm site and grid connection route. 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, 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 stilling ponds prior to controlled diffuse release over vegetated surfaces. There will be no direct discharges to surface waters.

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 10-5 below. A detailed drainage plan showing the layout of the proposed construction and operational drainage design elements as shown in Plate 10-5 and in Appendix 4-5.

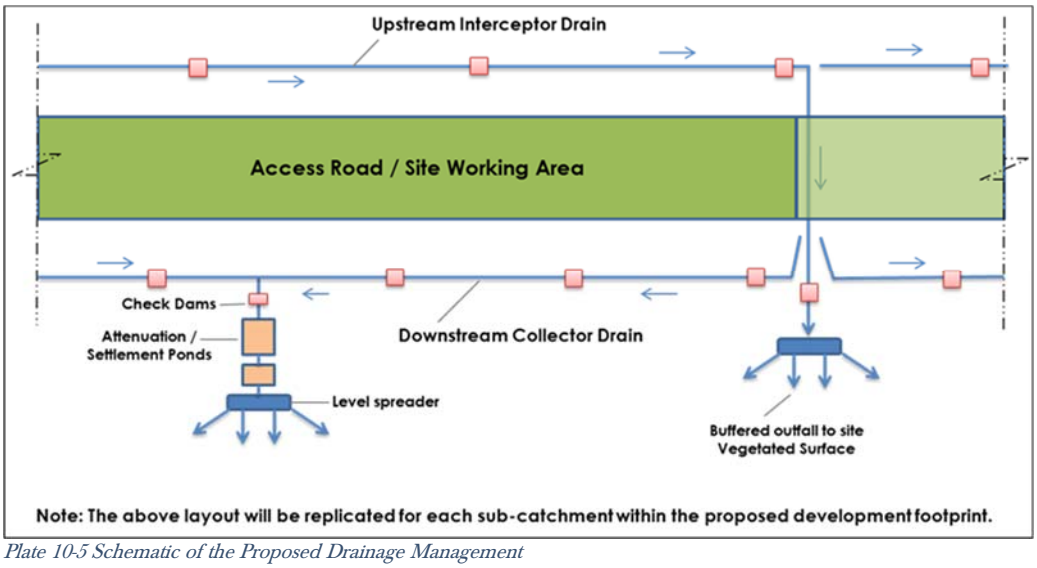


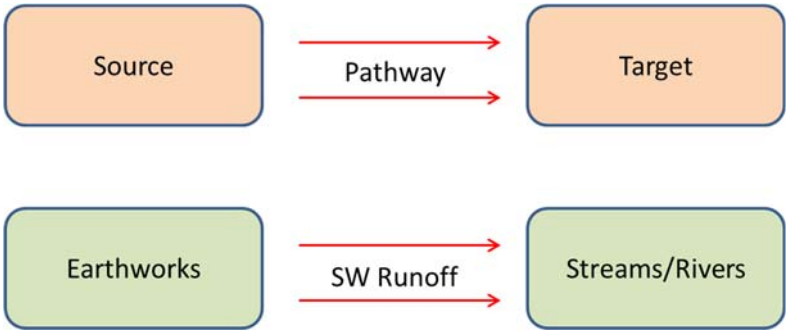
Plate 10-5 Schematic of the Proposed Drainage Management

10.5 Likely and Significant Impacts and Mitigation Measures

The potential impacts of the Proposed Development and mitigation measures that will be put in place to eliminate or reduce them are set out below.

10.5.1 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.



Where potential impacts are identified, the classification of impacts in the assessment follows the descriptors provided in the Glossary of Impacts contained in the following guidance documents produced by the Environmental Protection Agency (EPA):

- Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2017); and,
- Advice Notes For Preparing Environmental Impact Statements Draft (EPA, 2015.

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 10.5.3 and 10.5.4), we have firstly presented below a summary guide that defines the steps (1 to 7) taken in each element of the impact assessment process. 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 which have the potential to generate a source of significant adverse impact on the geological and hydrological/ hydrogeological (including water quality) environments.

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 a potential impact is 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 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 a potential impact is generated.
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.

10.5.2 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. Commercial forestry operations (including the associated drainage measures) would continue at the site.

The existing commercial forestry operations, peat cutting and agriculture can and will continue in conjunction with this proposed use of the site. Surface water drainage operating in areas of forestry will continue and may be extended in some areas.

10.5.3 Construction Phase

10.5.3.1 Clear Felling of Coniferous Plantation

It is estimated that 62.11 (hectares) in total of existing plantation forestry will be felled to allow for development of the proposed infrastructure. This total area also includes the felling requirement for the hen harrier enhancement plan (28ha), described in Chapter 8 Birds, which involves the felling of commercial forestry and the blocking of drains throughout the area to encourage peatland restoration.

Potential impacts during tree felling occur mainly from:

- Exposure of soil and subsoils due to vehicle tracking or forwarding extraction methods resulting in a source of suspended sediment which can become entrained in surface water runoff and enter surface watercourses;
- Entrainment of suspended sediment in watercourses due to vehicle tracking through watercourses;

- Damage to roads resulting in a source of suspended sediment which can become entrained in surface water runoff and enter surface watercourses;
- Release of sediment attached to timber in stacking areas; and,
- Nutrient release.

Pathways: Drainage and surface water discharge routes.

Receptors: Surface waters (Annageeragh River, Creegh River and Doonbeg River) and associated dependant ecosystems.

Pre-Mitigation Potential Impact: Indirect, negative, moderate, temporary, likely impact.

Proposed Mitigation Measures:

Best practice methods related to water incorporated into the forestry management and mitigation measures have been derived from:

- Forestry Commission (2004): Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh;
- Coillte (2009): Forest Operations and Water Protection Guidelines;
- Coillte (2009): Methodology for Clear Felling Harvesting Operations;
- Forest Service (Draft): Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures; and,
- Forest Service (2000): Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.

Mitigation by Avoidance:

There is a requirement in the Forest Service Code of Practice and in the FSC Certification Standard for the installation of buffer zones adjacent to aquatic zones at planting stage. Minimum buffer zone widths recommended in the Forest Service (2000) guidance document "Forestry and Water Quality Guidelines" are shown in Table 10-10.

Table 10-10 : Minimum Buffer Zone Widths (Forest Service, 2000)

Average slope leading to the aquatic zone		Buffer zone width on either side of the aquatic zone	Buffer zone width for highly erodible soils
Moderate	(0 – 15%)	10 m	15 m
Steep	(15 – 30%)	15 m	20 m
Very steep	(>30%)	20 m	25 m

During the wind turbine construction phase a self-imposed buffer zone of 50 metres will be maintained for all streams where possible. These buffer zones are shown on Figure 10-6. With the exception of existing road upgrades and proposed stream crossings all proposed tree felling areas are generally located outside of imposed buffer zones. Only Approximately 3.2ha of the proposed 62.11ha to be felled will be inside the 50 metre buffer zone. Additional mitigation (detailed below) will be carried where tree felling is required inside the buffer zones.

The large distance between most of the proposed felling areas and sensitive aquatic zones means that potential poor quality runoff from felling areas will be adequately managed and attenuated prior to even reaching the aquatic buffer zone and primary drainage routes. Where tree felling is required within the 50m buffer , the following additional mitigation measures will be employed.

Mitigation by Design:

Mitigation measures which will reduce the risk of entrainment of suspended solids and nutrient release in surface watercourses comprise best practice methods which are set out as follows:

- Machine combinations (i.e. hand held or mechanical) will be chosen which are most suitable for ground conditions and which will minimise soils disturbance;
- Checking and maintenance of roads and culverts will be on-going through any felling operation. No tracking of vehicle through watercourses will occur, as vehicles will use road infrastructure and existing watercourse crossing points. Where possible, existing drains will not be disturbed during felling works;
- Ditches which drain from the proposed area to be felled towards existing surface watercourses will be blocked, and temporary silt traps will be constructed. No direct discharge of such ditches to watercourses will occur. Drains and sediment traps will be installed during ground preparation. Collector drains will be excavated at an acute angle to the contour (~0.3%-3% gradient), to minimise flow velocities. Main drains to take the discharge from collector drains will include water drops and rock armour, as required, where there are steep gradients, and should avoid being placed at right angles to the contour;
- Sediment traps will be sited in drains downstream of felling areas. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of in the peat disposal areas. Where possible, all new silt traps will be constructed on even ground and not on sloping ground;
- In areas particularly sensitive to erosion or where felling inside the 50 metre buffer is required, it will be necessary to install double or triple sediment traps;
- All drainage channels will taper out before entering the 50m buffer zone. This ensures that discharged water gently fans out over the buffer zone before entering the aquatic zone, with sediment filtered out from the flow by ground vegetation within the zone. On erodible soils, silt traps will be installed at the end of the drainage channels, to the outside of the buffer zone;
- Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded. Correct drain alignment, spacing and depth will ensure that erosion and sediment build-up are minimized and controlled;
- Brash mats will be used to support vehicles on soft ground, reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal should take place when they become heavily used and worn. Provision should be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction should be suspended during periods of high rainfall;
- Timber will be stacked in dry areas, and outside a local 50 metre watercourse buffer. Straw bales and check dams to be emplaced on the down gradient side of timber storage/processing sites;
- Works will be carried out during periods of no, or low rainfall, in order to minimise entrainment of exposed sediment in surface water run-off;
- Checking and maintenance of roads and culverts will be on-going through the felling operation;
- Refuelling or maintenance of machinery will not occur within 100m of a watercourse. Mobile bowser, drip kits, qualified personnel will be used where refuelling is required;
- A permit to refuel system will be adopted;
- Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed, but care will be taken to avoid removing natural debris deflectors.
- Crossing of streams will not be permitted;

- Trees will be cut manually from along streams and using machinery to extract whole tree; and
- Travel only perpendicular to and away from stream.

Silt Traps:

Silt traps will be strategically placed down-gradient within forestry drains near streams. The main purpose of the silt traps and drain blocking is to slow water flow, increase residence time, and allow settling of silt in a controlled manner.

Drain Inspection and Maintenance:

The following items shall be carried out during pre-felling inspections and after:

- Communication with tree felling operatives in advance to determine whether any areas have been reported where there is unusual water logging or bogging of machines;
- Inspection of all areas reported as having unusual ground conditions;
- Inspection of main drainage ditches and outfalls. During pre-felling inspections the main drainage ditches shall be identified. Ideally the pre-felling inspection shall be carried out during rainfall;
- Following tree felling all main drains shall be inspected to ensure that they are functioning;
- Extraction tracks nears drains need to be broken up and diversion channels created to ensure that water in the tracks spreads out over the adjoining ground;
- Culverts on drains exiting the site will be unblocked; and,
- All accumulated silt will be removed from drains and culverts, and silt traps, and this removed material will be deposited away from watercourses to ensure that it will not be carried back into the trap or stream during subsequent rainfall.

Surface Water Quality Monitoring:

Sampling will be completed before, during (if the operation is conducted over a protracted time) and after the felling activity. The 'before' sampling should be conducted within 4 weeks of the felling activity commencing, preferably in medium to high water flow conditions. The "during" sampling will be undertaken once a week or after rainfall events. The 'after' sampling will comprise as many samplings as necessary to demonstrate that water quality has returned to pre-activity status (i.e. where an impact has been shown).

Criteria for the selection of water sampling points include the following:

- Avoid man-made ditches and drains, or watercourses that do not have year round flows, i.e. avoid ephemeral ditches, drains or watercourses;
- Select sampling points upstream and downstream of the forestry activities;
- It is advantageous if the upstream location is outside/above the forest in order to evaluate the impact of land-uses other than forestry;
- Where possible, downstream locations should be selected: one immediately below the forestry activity, the second at exit from the forest, and the third some distance from the second (this allows demonstration of no impact through dilution effect or contamination by other land-uses where impact increases at third downstream location relative to second downstream location); and,
- The above sampling strategy will be undertaken for all on-site sub-catchments streams where tree felling is proposed.

Also, daily surface water monitoring forms will also be utilised at every works site near any watercourse. These will be taken daily and kept on site for record and inspection.

Residual Impact: The potential for the release of suspended solids to watercourse receptors during tree felling is a risk to water quality and the aquatic quality of the receptor. Proven forestry best practice 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.

10.5.3.2 Earthworks (Removal of Vegetation Cover, Excavations and Stock Piling) Resulting in Suspended Solids Entrainment in Surface Waters

Construction phase activities that will require earthworks resulting in removal of vegetation cover and excavation of peat and mineral subsoil (where present) are detailed in Chapter 4 the Description of the Proposed Development. Potential sources of sediment laden water include:

- Drainage and seepage water resulting from infrastructure excavation;
- Stockpiled excavated material providing a point source of exposed sediment;
- Construction of the grid connection cable trench resulting in entrainment of sediment from the excavations during construction; and,
- Erosion of sediment from emplaced site drainage channels.

These activities can result in the release of suspended solids to surface watercourses 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 impacts are significant if not mitigated against.

Pathways: Drainage and surface water discharge routes.

Receptors: Down-gradient rivers (Annageeragh River, Creegh River and Doonbeg River) and dependant ecosystems.

Pre-Mitigation Potential Impact: Indirect, negative, significant, temporary, likely impact.

Mitigation by Avoidance:

The key mitigation measure during the construction phase is the avoidance of sensitive aquatic areas where possible. From Figure 10-6 it can be seen that all of the key areas of the Proposed Development are actually significantly away from the delineated buffer zones with the exception of existing road upgrades, new roads, proposed stream crossings and existing stream crossings requiring upgrading. 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 operated effectively. The proposed buffer zone will:

- Avoid physical damage to watercourses, and associated release of sediment;
- Avoid excavations within close proximity to surface water courses;
- 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.

Mitigation by Design:

- Source controls:
    - Interceptor drains, vee-drains, diversion drains, flume pipes, erosion and velocity control measures such as use of sand bags, oyster bags filled with gravel, filter fabrics, and other similar/equivalent or appropriate systems.
    - Small working areas, covering stockpiles, weathering off stockpiles, cessation of works in certain areas or other similar/equivalent or appropriate measures.
- In-Line controls:
    - Interceptor drains, vee-drains, oversized swales, erosion and velocity control measures such as check dams, sand bags, oyster bags, straw bales, flow limiters, weirs, baffles, silt bags, silt fences, sedimats, filter fabrics, and collection sumps, temporary sumps/attenuation lagoons, sediment traps, pumping systems, settlement ponds, temporary pumping chambers, or other similar/equivalent or appropriate systems.
- Treatment systems:
    - Temporary sumps and attenuation ponds, temporary storage lagoons, sediment traps, and settlement ponds, and proprietary settlement systems such as Siltbuster, and/or other similar/equivalent or appropriate systems.

It should be noted for this site that an extensive network of forestry and roadside drains already exists, and these will be integrated and enhanced as required and used within the wind farm development drainage system. The integration of the existing forestry drainage network and the proposed wind farm network is relatively simple. The key elements being the upgrading and improvements to water treatment elements, such as in line controls and treatment systems, including silt traps, stilling ponds and buffered outfalls.

The main elements of interaction with existing drains will be as follows:

- Apart from interceptor drains, which will convey clean runoff water to the downstream drainage system, there will be no direct discharge (without treatment for sediment reduction, and attenuation for flow management) of runoff from the proposed wind farm drainage into the existing site drainage network. This will reduce the potential for any increased risk of downstream flooding or sediment transport/erosion;
- Silt traps will be placed in the existing drains upstream of any streams where construction works / tree felling is taking place, and these will be diverted into proposed interceptor drains, or culverted under/across the works area;
- Runoff from individual turbine hardstanding areas will be not discharged into the existing drain network but discharged locally at each turbine location through stilling ponds and buffered outfalls onto vegetated surfaces;
- Buffered outfalls which will be numerous over the site will promote percolation of drainage waters across vegetation and close to the point at which the additional runoff is generated, rather than direct discharge to the existing drains of the site; and,
- Drains running parallel to the existing roads requiring widening will be upgraded, widening will be targeted to the opposite side of the road. Velocity and silt control measures such as check dams, sand bags, oyster bags, straw bales, flow limiters, weirs, baffles, silt fences will be used during the upgrade construction works. Regular buffered outfalls will also be added to these drains to protect downstream surface waters.

Water Treatment Train:

A final line of defence will be provided by a water treatment train such as a "Siltbuster". If the discharge water from construction areas fails to be of a high quality during regular inspections, 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 water courses 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 of these structures during construction phase is critical to their functioning to stated purpose. They will remain in place throughout the entire construction phase. Double silt fences will be placed within drains down-gradient of all construction areas inside the hydrological buffer zones

Silt Bags:

Silt bags will be used where small to medium volumes of water need to be pumped from excavations. As water is pumped through the bag, the majority of the sediment is retained by the geotextile fabric allowing filtered water to pass through. Silt bags will be used with natural vegetation filters or sedimats Sediment entrapment mats, consisting of coir or jute matting, will be placed at the silt bag location to provide further treatment of the water outfall from the silt bag. Sedimats will be secured to the ground surface using stakes/pegs. The sedimat will extend to the full width of the outfall to ensure all water passes through this additional treatment measure.

Pre-emptive Site Drainage Management

The works programme for the entire 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 vegetation 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 basis at the site to direct proposed construction activities:

- General Forecasts: Available on a national, regional and county level from the Met Eireann website (www.met.ie/forecasts). These provide general information on weather patterns including rainfall, wind speed and direction but do not provide any quantitative rainfall estimates;
- 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 Eireann website (www.met.ie/latest/rainfall_radar.asp). The images are a composite of radar data from Shannon and Dublin airports and give a picture of current rainfall extent and intensity. Images show a quantitative measure of recent rainfall. A 3-hour record is given and is updated every 15 minutes. Radar images are not predictive; and,
- Consultancy Service: Met Eireann provide a 24-hour telephone consultancy service. The forecaster will provide interpretation of weather data and give the best available forecast for the area of interest.

Using the safe threshold rainfall values will allow work to be safely controlled (from a water quality perspective) in the event of forecasting of an impending high rainfall intensity event.

Works will be suspended if forecasting suggests either of the following is likely to occur:

- >10 mm/hr (i.e. high intensity local rainfall events);
- >25 mm in a 24-hour period (heavy frontal rainfall lasting most of the day); or,
- >half monthly average rainfall in any 7 days.

Prior to works being suspended the following control measures should be completed:

- Secure all open excavations;
- Provide temporary or emergency drainage to prevent back-up of surface runoff; and,
- Avoid working during heavy rainfall and for up to 24 hours after heavy events to ensure drainage systems are not overloaded.

Management of Runoff from Peat and Subsoil Reinstatement Areas:

It is proposed that excavated peat will be used for landscaping throughout the site and any excess peat will be used to reinstate the 2 no. proposed borrow pits. All the proposed borrow pits are located outside the 50m stream and lake buffer zone (refer to Figure 10-6).

During the initial placement of peat and subsoil, silt fences, straw bales and biodegradable matting will be used to control surface water runoff from the reinstatement areas. 'Siltbuster' treatment trains will be employed if previous treatment is not to a high quality.

Drainage from peat reinstatement areas will ultimately be routed to an oversized swale and a number of stilling ponds pond and a 'Siltbuster' with appropriate storage and settlement designed for a 1 in 100 year 6 hour return period before being discharged to the on-site drains.

Peat/subsoil reinstatement areas will be sealed with a digger bucket and vegetated as soon possible to reduce sediment entrainment in runoff. Once re-vegetated and stabilised peat/subsoil reinstatement areas will no longer be a potential source of silt laden runoff.

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.

Monitoring:

An inspection and maintenance plan for the on-site construction drainage system will be prepared in advance of commencement of any works. 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. Inspections will also be undertaken after tree felling.

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. Checks will be carried out on a daily basis.

During the construction phase field testing and laboratory analysis of a range of parameters with relevant regulatory limits and EQSs will be undertaken for each primary watercourse, and specifically following heavy rainfall events (as per the CEMP is included in Appendix 4-4 of this EIAR).

Residual Impact: 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, short term, unlikely impact on down gradient rivers, water quality, and dependant ecosystems.

Significance of Effects: For the reasons outlined above, no significant effects on the surface water quality are anticipated.

10.5.3.3 Potential Impacts on Groundwater Levels During Excavation works & from proposed Borrow Pits

Dewatering of borrow pits (as required) and other deep excavations (i.e. turbine bases) have the potential to impact on local groundwater levels. However, groundwater level impacts are not anticipated to be significant due to the local hydrogeological regime and the proposed borrow pit excavation method as outlined below. Piling, which will be undertaken at the turbine locations as required, does not require dewatering and therefore has no potential to impact on groundwater levels.

No groundwater level impacts are predicted from the construction of the grid connection underground cabling trench, access roads, substation, compound or met mast due to the shallow nature of the excavation (i.e. 0 -~1.2m).

Pathway: Groundwater flowpaths.

Receptor: Groundwater levels.

Pre-Mitigation Potential Impact: Direct, negligible, slight, short term, unlikely impact.

Impact Assessment:

The proposed borrow pits (2 no.) are located in bedrock which is generally unproductive in terms of groundwater flow. No groundwater dewatering will be required as rock excavation will progress in a horizontal manner into the side of outcropping bedrock.

The topographical and hydrogeological setting of the proposed borrow pits locations means no significant groundwater dewatering will be required during the works to the borrow pits during the construction phase. Moreover, direct rainfall and surface water runoff will be the main inflows that will require water volume and water quality management. For the avoidance of doubt. we would generally define dewatering as a requirement to permanently drawdown the local groundwater table by means of over pumping, e.g. as would be required for the operation of a bedrock quarry in a valley floor. We consider that this example is very different in scale and operation from the proposed operation of a temporary shallow borrow pit on the side of a hill. In order to explain this thoroughly we will outline our reasoning in a series of bullet points as follows:

- Firstly, the borrow pit areas are located on the side of local hills where the ground elevations are between 120 and 130m OD and therefore are rock outcrops;
- These elevations are above the elevations of the local valleys and streams;
- The proposed borrow pits will be between approximately 8 – 10m below ground level which is notable. However, in the context of the topographical/elevated setting of the borrow pits, this depth range is relatively shallow;

- The local bedrock comprises granite and is known to be generally unproductive. This means that groundwater flows will be relatively minor;
- The flow paths (i.e. the distance from the point of recharge to the point of discharge) in this type of geology is short, localised, and will also be relatively shallow;
- No regional groundwater flow regime, i.e. large volumes of groundwater flow, will be encountered at these elevations;
- Therefore shallow groundwater inflows will largely be fed by recent rainfall, and possibly by limited groundwater seepage form localised shallow bedrock;
- The sloping nature of the ground on the hills where the borrow pits are proposed along with the coverage of soil means groundwater recharge is going to be very low;
- As such the shallow groundwater flow system will be small in comparison to the expected surface water flows from the bog surface;
- This means that there will be a preference for high surface water runoff as opposed to groundwater recharge and flow; and,
- Hence, we consider that the management of surface water will form the largest proportion of water to be managed and treated.

Environmental management guidelines from the EPA quarry 2006 guidance document – *"Environmental Management in the Extractive Industry"* in relation to groundwater issues will be implemented during the construction phase.

In terms of local well supplies, the assessment undertaken in Section 10.3.11 above identified no potential wells within the same sub-catchments as the proposed development. Therefore, there is no well supplies down-gradient of any proposed development area that can be impacted on.

Residual Impact: 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 borrow pit 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 – Negative, imperceptible, direct, short term, unlikely impact on groundwater levels, and Negative, imperceptible, short term, unlikely impact on groundwater quality.

Significance of Effects: For the reasons outlined above, no significant effects on groundwater levels and groundwater quality are anticipated.

10.5.3.4 Excavation Dewatering and Potential Impacts on Surface Water Quality

Some minor groundwater/surface water seepages will likely occur in turbine base excavations, the borrow pits and sections of the grid connection and internal cabing trenches, and this will create additional volumes of water to be treated by the runoff management system. 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.

Pathway: Overland flow and site drainage network.

Receptor: Down-gradient surface water bodies (Annageeragh River, Creegh River and Doonbeg River).

Pre-Mitigation Potential Impact: Indirect, negative, significant, temporary, unlikely impact to surface water quality.

Proposed Mitigation Measures:

Management of groundwater 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 site constructed drainage system or onto natural vegetated surfaces and not directly to surface waters;
- The pumped water volumes will be discharged via volume and sediment attenuation ponds adjacent to excavation areas, or via specialist treatment systems such as a Siltbuster unit;
- There will be no direct discharge to surface watercourses, and therefore no risk of hydraulic loading or contamination will occur;
- Daily monitoring of 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; and,
- A mobile 'Siltbuster' or similar equivalent specialist treatment system will be available on-site for emergencies in order to treat sediment polluted waters from settlement ponds or excavations should they occur. Siltbusters are mobile silt traps that can remove fine particles from water using a proven technology and hydraulic design in a rugged unit. The mobile units are specifically designed for use on construction-sites. They will be used as final line of defence if needed.

Residual Impact: 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, short term, unlikely impact on local surface water quality.

Significance of the Effects: For the reasons outlined above, no significant effects on the surface water quality are anticipated.

10.5.3.5 Potential Release of Hydrocarbons during Construction and Storage

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a significant pollution risk to groundwater, surface water and associated ecosystems, and to terrestrial ecology. The accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbon has 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 (Annageeragh River, Creegh River and Doonbeg River).

Pre-Mitigation Potential Impact:

Indirect, negative, slight, short term, likely impact to local groundwater quality.

Indirect, negative, significant, short term, unlikely impact to surface water quality.

Proposed Mitigation Measures:

Mitigation measures proposed to avoid release of hydrocarbons at the site are as follows:

- On site re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled off site, and will be towed around the site by a 4x4 jeep to where machinery is located. 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 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;
- Onsite refuelling will be carried out by trained personnel only;
- A permit to fuel system will be put in place;
- Fuels stored on site will be minimised. Fuel storage areas if required will be bunded appropriately for the fuel storage volume for the time period of the construction and fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used during construction 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 included within the Construction and Environmental Management Plan (Appendix 4.4). Spill kits will be available to deal with and accidental spillage in and outside the re-fuelling area.

Residual Impact: 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, short term, unlikely impact to local groundwater quality. Negative, imperceptible, indirect, short term, unlikely impact to surface water quality.

Significance of Effects: For the reasons outlined above, no significant effects on surface water or groundwater quality are anticipated.

10.5.3.6 Groundwater and Surface Water Contamination from Wastewater Disposal

Release of effluent from domestic wastewater treatment systems has the potential to impact on groundwater and surface waters if site conditions are not suitable for an on-site percolation unit.

Pathway: Groundwater flowpaths and site drainage network.

Receptor: Down-gradient well supplies, groundwater quality and surface water quality (Annageeragh River, Creegh River and Doonbeg River).

Pre mitigation Impact:

Indirect, negative, significant, temporary, unlikely impact to surface water quality.

Indirect, negative, slight, temporary, unlikely impact to local groundwater.

Proposed Mitigation Measures:

- 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 permitted waste collector to wastewater treatment plants. It is not proposed to treat wastewater on-site.

Residual Impact: No residual impact.

Significance of Effects: No significant effects on surface water or groundwater quality are anticipated.

10.5.3.7 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 Quality of Salmonid Water Regulations, with artificial variations not in excess of ± 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 environment. 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 Impact: Indirect, negative, moderate, short term, likely impact 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.
- Where concrete is delivered on site, only the chute will be cleaned, using the smallest volume of water practicable. 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 will be undertaken at lined cement washout ponds.
- Weather forecasting will be used to plan dry days for pouring concrete.
- The pour site will be kept free of standing water and plastic covers will be ready in case of sudden rainfall event.

Residual Impact: 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 of 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, unlikely impact to surface water quality.

Significance of the Effect: For the reasons outlined above, no significant effects on surface water quality are anticipated.

10.5.3.8 Morphological Changes to Surface Water Courses & Drainage Patterns

Diversion, culverting and bridge crossing of surface watercourses can result in morphological changes, changes to drainage patterns and alteration of aquatic habitats. Construction of structures over water courses has the potential to significantly interfere with water quality and flows during the construction phase.

It is proposed that 4 no. new stream crossings and 1 no. existing stream crossing upgrades will be required to facilitate the wind farm site development infrastructure.

Along the grid connection there are a total of 9 no. new watercourse crossings (all of which are located in the Annageeragh River catchment) and of these 9, 7 no. drain into Doo Lough. The watercourses crossed by the grid connection are second/third order stream which flow into Doo Lough from the east.

Pathway: Site drainage network.

Receptor: Surface water flows (Annageeragh River and Creegh River), stream morphology and water quality.

Pre-Mitigation Potential Impact: Negative, direct, slight, long term, likely impact.

Proposed Mitigation Measures:

- All proposed new stream crossings will be bottomless or clear span culverts and the existing banks will remain undisturbed. No in-stream excavation works are proposed and therefore there will be no direct impact on the stream at the proposed crossing location;
- Where the proposed underground cabling route follows an existing road or road proposed for upgrade, the cable will pass over or below the culvert within the access road;
- All guidance / mitigation measures proposed by the OPW or the Inland Fisheries Ireland[2] is incorporated into the design of the proposed crossings;
- As a further precaution, near stream construction work, will only be carried out during the period permitted by Inland Fisheries Ireland for in-stream works according to the Eastern Regional Fisheries Board (2004) guidance document "Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites", i.e., May to September inclusive. This time period coincides with the period of lowest expected rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses (any deviation from this will be done in discussion with the IFI);
- During the near stream construction work double row silt fences will be emplaced immediately down-gradient of the construction area for the duration of the construction phase. There will be no batching or storage of cement allowed in the vicinity of the crossing construction areas; and,
- All new river/stream crossings will require a Section 50 application (Arterial Drainage Act, 1945). The river/stream crossings will be designed in accordance with OPW guidelines/requirements on applying for a Section 50 consent.

With respect to the grid connection watercourse crossings, 4 construction crossing methods are proposed that will avoid in-stream works and these include:

- Method 1 - Where no crossing culvert currently exists, the cable will pass over the watercourse on a new bottomless box culvert or pre-cast concrete slab in a standard trefoil arrangement;
- Method 2 - Where the required depth above the culvert to accommodate the standard trench is achieved in the road, the cabling will pass below the road surface; and,
- Method 3 - Where the required depth above the culvert to accommodate the standard trench cannot be achieved in the road, the cabling will pass over the culvert in a flatbed formation.

[2] *Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters*

- Method 4 - In the event that none of the above methods are appropriate, directional drilling will be utilised. Mitigation Measures relating to the use of a mixture of a natural, inert and fully biodegradable drilling fluid such as Clear Bore™ and water for directional drilling include:
    - The area around the Clear Bore™ batching, pumping and recycling plants shall be bunded using terram and sandbags in order to contain any spillages;
    - One or more lines of silt fences shall be placed between the works area and adjacent rivers and streams on both banks;
    - Accidental spillage of fluids shall be cleaned up immediately and transported off site for disposal at a licensed facility; and,
    - Adequately sized skips will be used for temporary storage of drilling arisings during directional drilling works. This will ensure containment of drilling arisings and drilling flush.

Residual Impact: With the application of the best practice mitigation outlined above, we consider the residual effect to be - Negative, imperceptible, direct, long term, unlikely impact on stream flows, stream morphology and surface water quality.

Significance of Effects: For the reasons outlined above, no significant effects on stream morphology or stream water quality are anticipated at crossing locations.

10.5.3.9 Potential Hydrological Impacts on Designated Sites

The designated sites that are hydraulically connected (surface water flow paths only) to the proposed wind farm development include the Mid-Clare Coast SPA (Site Code 004182), Carrowmore Point to Spanish Point and Islands cSAC (Site Code 001021) and White Strand/Carrowmore Marsh (Site Code 001007). From a hydrological perspective there will be low risk of impact on these marine designated sites as they are not freshwater dependant ecosystems and therefore less sensitive to sediment input which is the main potential pollutant from wind farm site, particularly during construction. However, as described in this chapter measures will be put in place to prevent surface water quality impacts.

Pathway: Surface water flowpaths.

Receptor: Down-gradient water quality and designated sites.

Pre-Mitigation Potential Impact: Indirect, negative, imperceptible, short term, likely impact.

Impact Assessment & Proposed Mitigation Measures:

Due to the nature and scale of the development, the downstream distance (~8km) and the fact the downstream designated sites are not freshwater dependant habitats, no impacts are anticipated.

Nevertheless, mitigation measures for surface water quality protection are summarised again below:

The proposed mitigation measures which will include buffer zones and drainage control measures (i.e. interceptor drains, swales, stilling ponds) will ensure that the quality of runoff from proposed development areas will be very high. As stated in Impact Section 10.5.3.2 above, there could potentially be an “imperceptible, short term, likely impact” on local streams and rivers but this would be very localised and over a very short time period (i.e. hours). Therefore, no significant direct, or indirect impacts on the downstream designated sites will occur.

Residual Impact: No impacts.

Significance of Effects: No significant impacts on designated sites are anticipated.

10.5.3.10 Potential Effects on Local Groundwater Well Supplies

A baseline definition of groundwater flow at the study site is outlined in Section 10.3.4 and Section 10.3.10. Using this conceptual model of groundwater flow an impact assessment for local wells is undertaken below.

Pathway: Groundwater flowpaths.

Receptor: Groundwater Supplies.

Pre-Mitigation Potential Impact: Negative, imperceptible, indirect, long term, low probability effect.

Impact Assessment

With respect to the southern section of the wind farm site, groundwater flow directions will be towards the 3 main streams which flow through the site (i.e. Streams S1, S2 and S3). There are no mapped houses within the groundwater flow path downstream of these turbine locations, borrow pit or substation and therefore there is no potential to impact on groundwater well supplies.

Similarly, on the north of the wind farm site, groundwater drainage will be towards Stream S4 which flows westerly close to the northern boundary of the wind farm site. There are no dwelling houses between the proposed development infrastructure and stream S4 therefore there is no potential for impact.

With respect to the proposed grid connection options, no impacts on groundwater wells will occur due to the shallow nature of the proposed cable trench (~1.2m).

Also, the wind farm is designed so that turbines are at least 750m from surrounding dwelling houses.

Residual Effects: For the reasons outlined in the impact assessment above (separation distances, and prevailing geology, topography and groundwater flow directions), It has been assessed there is no potential to impact on local wells.

Significance of Effects: For the reasons outlined above, no impacts on groundwater supplies will occur.

10.5.3.11 Surface Water Quality Impacts on Doo Lough Public Water Supply (PWS)

Doo Lough, which exists downstream of the grid connection is used as public water supply for the west Clare area. None of proposed wind farm site itself is located in the surface water catchment to Doo Lough.

Pathway: Local drainage network.

Receptor: Doo Lough PWS abstraction

Pre-Mitigation Potential Impact: Indirect, negative, imperceptible, long term, unlikely impact.

Impact Assessment & Proposed Mitigation Measures:

As stated previously in the chapter, a comprehensive surface water management plan and drainage plan has been prepared for the Proposed Development and this will ensure that surface water runoff from the developed areas of the site will be of a high quality and will therefore not impact on the quality of downstream rivers and lakes. During the layout optimisation process, all surface waters at the site were classified as very sensitive (the criteria for this are presented in Table 10-1 of the EIAR). Very

sensitive surface waters are receptors of high environmental importance such as designated sites (i.e. NHA or SAC), or public drinking water supplies. The surface waters at the proposed development were applied the highest possible sensitivity rating and appropriate mitigation measures which include avoidance and best practice engineering design measures are proposed to avoid significant impacts.

In addition, large lakes by their nature are natural sinks for suspended sediments that are transported in by rivers and streams. The retention time of water in lakes the size of Doo Lough (area of approximately 1.3km^2) would be significant and this would ensure that the majority of suspended sediments would settle out prior to the water leaving the lake (it should be noted that the Doo Lough abstraction is at the outfall end of the lake and therefore water which enters via streams along the grid connection must pass through the entire length of the lake before it is abstracted and therefore attenuation is maximised).

To demonstrate the retention capacity of Doo Lough the volume of the lake is estimated using a conservative average depth of 1.5m. Based on a plan area of 1.3km^2 the total lake volume would be calculated at 1,950,0000m^3. Based on a 5%ile flow of 29,880m^3/hr (EPA Hydro-tool) for the Annageeragh River at the lake outfall, there would be a retention time 65 hours. Based on a 50%ile flow of 7,416m^3/hr, the retention time would be 263 hours. For comparison purposes, the EPA guidance document - *Environmental Management in the Extractive Industry (Non-Scheduled Minerals)* recommends for the removal of fine sized silt particles (0.004mm) settlement ponds should have a minimum 24-hour retention period.

It should be noted that the proposed wind farm drainage design does not rely on the assimilative capacity of streams or lakes to reduce potential water quality impacts. The potential impacts on surface water quality of local streams were determined to be imperceptible to slight and only on a temporary basis. Therefore, surface water quality impacts on the downstream Doo Lough will not occur and therefore impacts on the Doo Lough surface water abstraction will also not occur.

Residual Impact: No impacts on Doo Lough PWS are anticipated.

Significance of Effects: No significant effects on Doo Lough PWS are anticipated.

10.5.3.12 Impacts on Downstream Freshwater Pearl Mussel Populations

The proposed windfarm is located within the Annageeragh, Creegh and Doonbeg River catchments where there are freshwater pearl mussel populations present and there is a potential for impacts on water quality and substrate conditions as a result of the Proposed Development. The freshwater pearl mussels are not a qualifying interest of the local designated sites.

The Clare County Council scoping response refers predominately to the Annageeragh catchment as it has been shown to have some suitable substrate and records of adult mussels in a recent study undertaken by EirEco in 2016. It is highly likely given the results of the 2016 survey the species can be considered effectively extinct in the Creegh catchment owing to severe historical and ongoing drainage along most of its channel.

Pathway: Site drainage network.

Receptor: Freshwater Pearl Mussel

Pre-Mitigation Potential Impact: Indirect, negative, slight, temporary, likely impact.

Impact Assessment & Proposed Mitigation Measures:

As discussed above, the northern section of the site (only 3 no. of 10 turbines) is located within the Annageeragh River catchment while the southern section of the site (7 no. of 10 turbines) is located within the Creegh River catchment. This is positive in terms of impacts of freshwater pearl mussel populations, as the Annageeragh River is the most sensitive. It is considered that the populations in the Creegh catchment are effectively extinct.

The majority of the grid connection route is located in the Annageeragh River catchment (180m of the grid near the Booltiagh WF Substation extends into the Doonbeg River catchment). Within the Annageeragh River catchment, the grid connection route is largely located upstream of Doo Lough and the fresh water pearl mussel populations are located downstream of Doo Lough. Even in the absence of mitigation, no impacts on the Annageeragh River downstream of Doo Lough due to the grid works is anticipated due to the attenuation provided by Doo Lough. No impacts on freshwater pearl mussel populations will occur in the Doonbeg River catchment due to the minimal amount of work proposed (180m).

The design team were at all times aware that freshwater pearl mussel populations existed in the downstream watercourses, and as such all proposed mitigation and drainage design proposals were designed towards providing a "best in class" drainage management proposal for the development considering the significant catchment sensitivities.

During the layout optimisation process, all surface waters at the site were classified as very sensitive (the criteria for this are presented in Table 10-1 of the EIAR). Very sensitive surface waters are receptors of high environmental importance such as designated sites (i.e. NHA or SAC) or a public drinking water supply source. The surface waters at the proposed development were applied the highest possible sensitivity rating.

As stated previously in the chapter, a comprehensive surface water management plan and drainage plan is proposed and this will ensure that surface water runoff from the developed areas of the site will be of a high quality and will therefore not impact on the quality of downstream rivers.

Detailed drainage management design and pollution prevention measures proposed during the construction phase are presented above in this chapter. These proposals are best in class and in line with current best practice approaches for surface water quality protection on wind farm and forestry sites.

To emphasise the high level of attenuation and treatment that will be put in place during the construction phase we have provided a process flow diagram for the following elements of the proposed development:

- Borrow Pits
- Turbine bases
- Access Roads

An illustration of the various levels of controls proposed for borrow pit discharges is shown as Plate 10-6.

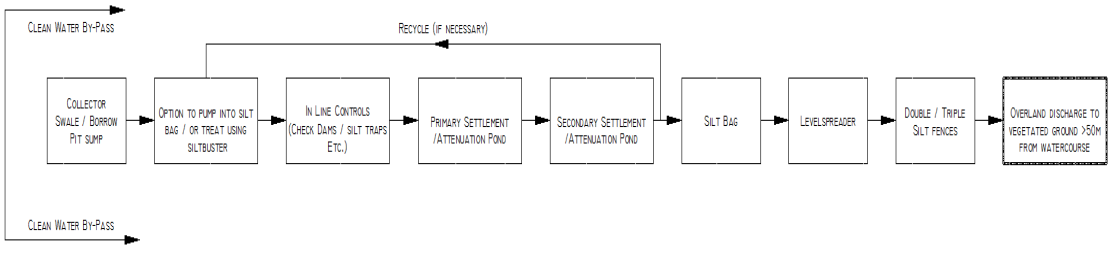


Plate 10-6 Water Treatment Train for Borrow Pits.

An illustration of the various levels of controls proposed for turbine base discharges is shown as Plate 10-7.

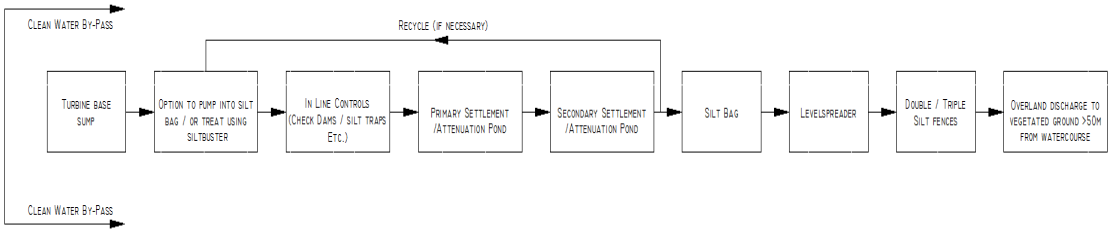


Plate 10-7 Water Treatment Train for Turbine Bases.

An illustration of the various levels of controls proposed for construction and upgrading of access roads is shown as Plate 10-8.

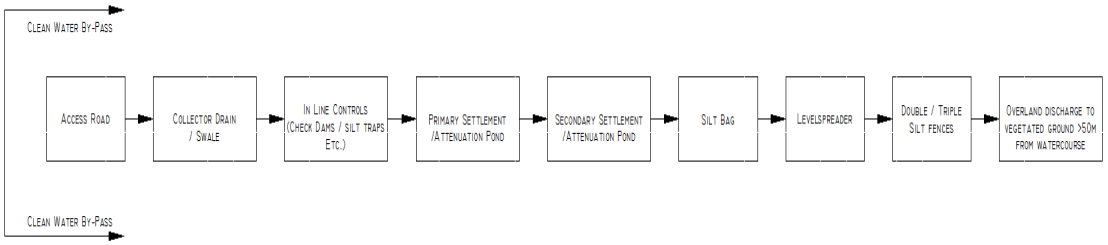


Plate 10-8 Water Treatment Train for Access Roads.

The process flow diagrams demonstrate that while settlement ponds form an important element of the drainage proposals for the site, they are not stand alone but occur as part of a treatment train of systems that will be applied in series to ensure protection of downstream watercourses. The treatment of site runoff occurs before and also continues after the settlement ponds, with the "after" treatment also utilising natural elements of the site such as the existing vegetated ground. Therefore, the final "polished" discharge effluent quality will not be achieved until the discharge passes through the last element of the treatment series train which is the vegetated ground upslope of the local watercourse (i.e. compliance point).

A final line of defence can be provided by a water treatment train such as a "Siltbuster" if required. If the discharge water from construction areas fails to be of a high quality then a filtration treatment system (such as a 'Siltbuster' or similar equivalent treatment train (sequence of water treatment processes) will be used to filter and treat all surface discharge water collected in the dirty water drainage system. This will apply for all of the construction phase.

Daily inspections will be undertaken to assess the effectiveness of the water treatment trains and this will include a visual assessment of water quality and also portable probes for field hydrochemistry monitoring (turbidity, pH, electrical conductivity etc) will be used by the Ecological Clerk of Works (ECoW) to make on the spot checks.

Residual Impact: Indirect, negative, imperceptible, temporary, likely impact.

Significance of Effects: No significant effects on the freshwater pearl mussel populations will occur.

10.5.4 Operational Phase

10.5.4.1 Progressive Replacement of Natural Surface with Lower Permeability Surfaces

The potential for increased surface water runoff is the primary potential impact during the operational phase of the Proposed Development.

Progressive replacement of the vegetated surface with impermeable surfaces will decrease the permeability of the ground within the wind farm site footprint(i.e turbine bases, hardstandings, substation and to a lesser extent the new access roads). The permeability along the internal grid connection through the wind farm site will not be significantly altered, as the fill material will not be compacted. This will result in an increase in the proportion of surface water runoff reaching the surface water drainage network as outlined in Table 10-11.

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 1,231m^3/month (Table 10-11). This represents a potential increase of approximately 0.15 % in the average daily/monthly volume of runoff from the site area in comparison to the baseline pre-development site runoff conditions (Table 10-7).

This is a very small increase in average runoff and results from a relatively small area of the overall Proposed Development site being developed. Specifically, the proposed permanent development footprint is approximately 14.5ha, representing 2.7% of the total study area of 538ha.

The additional volume is low due to the fact that the runoff potential from the wind farm site is naturally high (95%). Also, this calculation assumes that all hardstanding areas will be impermeable which considered to be a worst case scenario and is unlikely to be the case. The increase in runoff from most of the development catchment will therefore be negligible and this is before mitigation measures will be put in place. Therefore, there will be no risk of exacerbated flooding down-gradient of the site.

Table 10-11: Baseline Site Runoff V Development Runoff

Baseline Runoff/month (m^3)	Baseline Runoff/day (m^3)	Permanent Footprint Area (m^2)	Footprint Area 100% Runoff (m_3) (m^3)	Footprint Area 95% Runoff (m^3)	Net Increase/month (m^3)	Net Increase/day (m^3)	% Increase from Baseline Conditions (m^3)
817,000	26,355	143,100	24,613	23,383	1,231	39.7	0.15

Pathway: Site drainage network.

Receptor: Surface waters (Annageeragh River, Creegh River and Doonbeg River) and dependant ecosystems.

Pre-Mitigation Potential Impact: Negative, slight, indirect, permanent, moderate probability effect on all downstream surface water bodies.

Proposed Mitigation by Design:

The operational phase drainage system of the Proposed Development will be installed and constructed in conjunction with the road and hardstanding construction work as described below and as shown on the Drainage drawings submitted with this planning application:

- 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 over the ground by means of a level spreader;
- Swales/road side drains will be used to collect runoff from access roads and turbine hardstanding areas of the site, likely to have entrained suspended sediment, and channel it to settlement ponds for sediment settling;
- On steep sections of access road transverse drains ('grips') will be constructed in the surface layer of the road to divert any runoff off the road into swales/road side 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 road swale 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 watercourses; and,
- Settlement ponds will be designed in consideration of the greenfield runoff rate.

Residual Impact: Direct, negative, neutral, long term, likely impact.

Significance of Effects: No significant effects on surface water quality or quantity will occur during the operational phase of the Proposed Development.

10.5.5 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. A description of the decommissioning works is contained in Chapter 4 of this EIAR.

During decommissioning, it will be possible to reverse or at least reduce some of the potential effects caused during construction, and to a lesser extent operation, by rehabilitating constructed areas such as turbine bases and 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.

The wind farm site roadways will be kept and maintained following decommissioning of the wind farm infrastructure, as these will be utilised by ongoing forestry works and by local farmers.

The electrical cabling connecting the site infrastructure to the on-site substation will be removed, while the ducting itself will remain in-situ rather than excavating and removing it, as this is considered to have less of a potential environmental impact, in terms of soil exposure, and thus on the possibility of the generation of suspended sediment which could enter nearby watercourses.

The turbines will be removed by disassembling them in a reverse order to their erection. This will be completed using the same model cranes as used in their construction. They will then be transported off-site along their original delivery route. The disassembly and removal of the turbines will not have an impact on the hydrological/hydrogeological environment at the wind farm site.

Other impacts such as possible soil compaction and contamination by fuel leaks will remain but will be of reduced magnitude than the construction phase because of the smaller scale of the works and reduced volumes on-site

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 as a permanent part of the national grid. The turbine bases will be rehabilitated by covering with local topsoil/peat in order to regenerate vegetation which will reduce runoff and sedimentation effects. 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.

10.5.6 Risk of Major Accidents and Disasters

None, as indicated above the risk of flooding at the wind farm site is determined to be negligible/none.

10.5.7 Cumulative Impacts

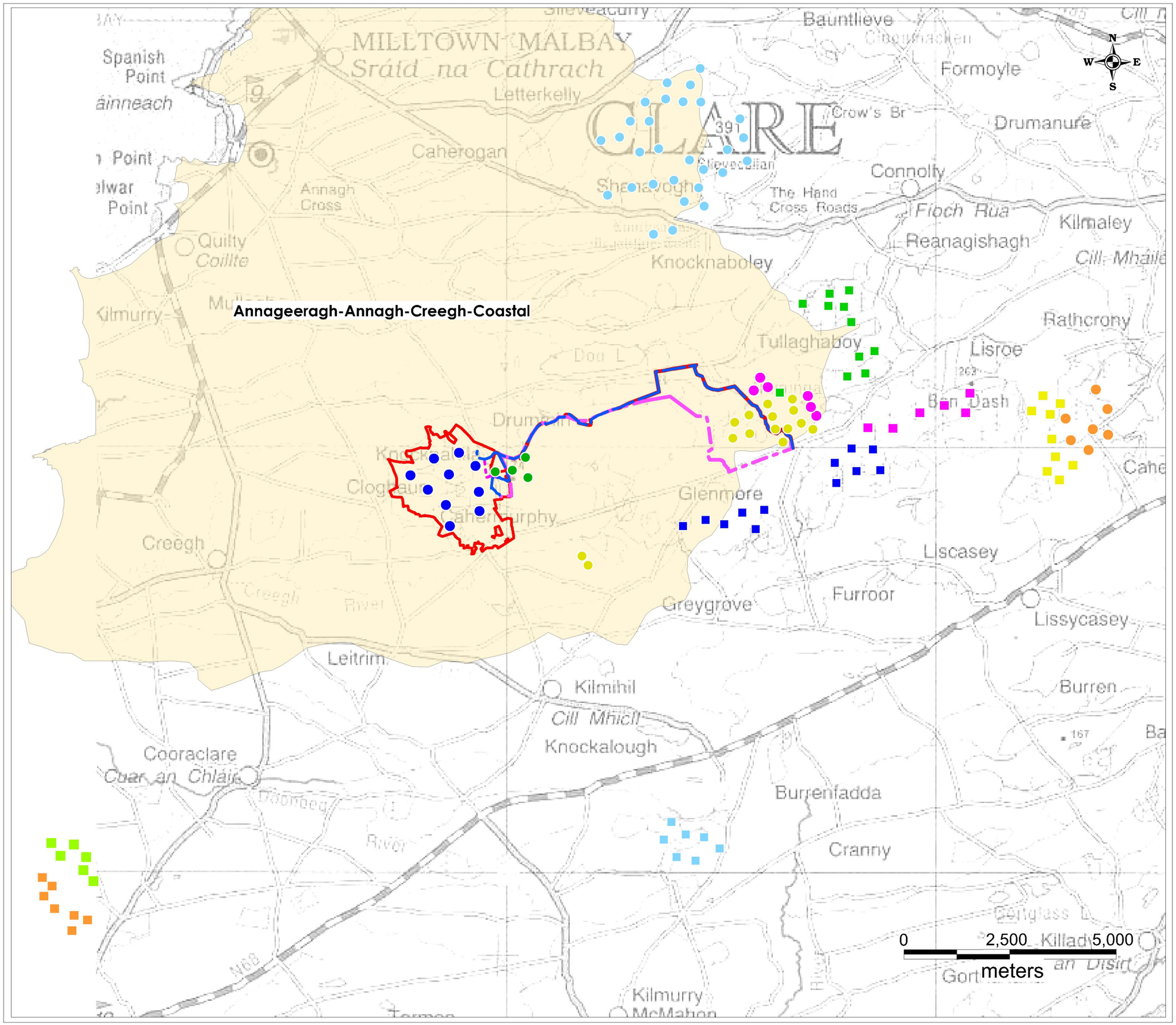
The majority of the windfarm turbines (7 no. of 10 proposed turbines) are located in the Creegh River sub-catchment while the majority of the grid connection route options and 3 no. of the 10 proposed turbines are located in the Annageeragh River sub-catchment. In addition, the grid connection route is mainly located upstream of the Doo Lough and therefore the grid works (even in the absence of mitigation) are not expected to contribute to cumulative effects with respect to the wind farm works in the Annageeragh River downstream of Doo Lough.

A cumulative impact assessment was undertaken regarding other wind farm developments located within the Annageeragh River and Creegh River sub-catchments. The developments assessed are listed in Table 10-12 below and are shown on Figure 10-7. There are no other types of developments (as listed in Chapter 2, Section 2.5) within the Annageeragh River or Creegh River catchments to contribute to significant cumulative hydrological impacts.

In terms of the potential impacts of developments on downstream surface water bodies, 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 the Creegh River and the Annageeragh River sub-catchments the vast majority of the other windfarm developments are either operational or currently being constructed, therefore construction phase impacts with the proposed Cahermurphy Phase Two Wind Farm cannot occur if the development is permitted.

In terms of operational phase hydrological effects, the total number of turbines that could potentially be operating within the Creegh River Catchment is 30 no. (which includes 7 no. from the proposed Cahermurphy Phase Two WF). The total catchment area of the Creegh River catchment is ~88km^2 and therefore this equates to 1 turbine for approximately every ~2.9km^2 which would not be considered high density. Therefore, effects on catchment hydrology and water quality are not be expected.

In terms of operational phase hydrological effects, the total number of turbines that could potentially be operating within the Annageeragh River catchment is 24 no. (which includes 3 no. from the proposed Cahermurphy Phase Two WF). The total catchment area of the Annageeragh River catchment is ~66km^2 and therefore this equates to 1 turbine for approximately every ~2.6km^2 which would is considered to be a low density and therefore, effects on the Annageeragh River catchment are not anticipated.



Legend

- EIAR Site Boundary
- Proposed Cahermurphy WF Turbine Layout
- Proposed Cable Route
- Proposed Alternative Cable Route

- Booltiagh WF
- Booltiagh WF Extension
- Boolynagleragh WF
- Boolynagleragh WF Extension
- Cahermurphy WF
- Crossmore WF
- Glenmore WF
- Letteragh WF
- Moanmore WF
- Moneypoint WF
- Slaghbooly WF
- Slieve Callan WF
- Tullabrack WF

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Client: MKO	
Job: Cahermurphy WF, Co. Clare	
Title: Cumulative Impact Assessment Map	
Figure No: 10-7	
Drawing No: P1477-0-0720-A3-10-7-0A	
Sheet Size: A3	Project No: P1477-0
Scale: 1:85,000	Drawn By: GD
Date: 14/07/2020	Checked By: MG

Therefore, no hydrological cumulative effects with respect other windfarm developments is anticipated.

With regard non-wind farm related forestry activities and the potential for cumulative impacts, all Coillte scheduled tree felling or replanting will be planned around the Proposed Development construction phase in order to prevent hydrological cumulative impacts. No scheduled tree felling will occur in the same local catchment where wind farm construction is taking place. It is noted that all general forestry activity will be curtailed on the site during the construction of the proposed development.

The replanting lands are located in counties Roscommon, Clare, Galway and Cavan and in a different water catchment and therefore are not likely to contribute to potential cumulative impacts with the proposed wind farm development. The potential direct, indirect and cumulative impacts of replanting lands on water has been assessed in the Section 7 of Appendix 4-3 Assessment of Forestry Replacement Lands.

Table 10-12: List of Other Developments Assessed for Hydrological Cumulative Impacts

Regional Catchment	Wind Energy Developments	Total Turbine No.	Turbine No. in Catchment
Creegh	Kiltumper WF (Operational)	2	2
	Booltiagh WF (Operational)	13	3
	Glenmore WF (Under Construction)	12	12
	Letteragh WF (Operational)	6	6
Totals		**33**	**23**
Annageeragh	Cahermurphy Phase 1 WF (Operational)	4	4
	Booltiagh WF (Operational)	13	10
	Booltiagh WF Extension (Operational)	6	6
	Slievecallan WF (Operational)	29	1
Totals		**52**	**21**

10.5.8 Conclusion

During each phase of the proposed development (construction and operation / maintenance and decommissioning) a number of activities will take place on the site of the Proposed Development, 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 avoid impact on downstream designated sites. A self-imposed 50m stream and lake buffer was used during the layout 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 (Refer to Appendix 4-4).

Overall the proposed development presents no significant impacts to surface water and groundwater quality provided the proposed mitigation measures are implemented.

The hen harrier enhancement plan involves the felling of commercial foirestry near the site and the blocking of drains throughout the area to encourage peatland restoration. All felling works will be undertaken in full accordance with the Coillte standard operating procedures and forest guidelines as detailed in Section 10.5.3.1 and therefore no significant impacts are anticipated.

No significant cumulative impacts on any of the regional surface water catchment or groundwater bodies will occur from the Proposed Development including the associated grid connections and other wind farm developments.

11. AIR AND CLIMATE

11.1 Introduction

11.1.1 Background

The site of the proposed wind farm development is located approximately 5 kilometres to the north of Kilmihil and 25 kilometres southwest of Ennis, Co. Clare. The townlands in which the proposed development is located, including the grid connection route, are listed in Table 1.1 in Chapter 1 of this EIAR. The primary land-uses within and in the vicinity of the site comprise forestry, turbary, wind energy and agriculture. 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. It is expected that air quality in the existing environment is good, since there are no major sources of air pollution (e.g. heavy industry) in the vicinity of the site.

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

11.1.2 Statement of Authority

This section of the EIAR has been prepared by Eoin O'Sullivan and reviewed by Michael Watson, both of MKO. Eoin is an experienced geo-environmental scientist and has over ten years' experience in the assessment of a wide range of energy and infrastructure related projects and working in the fields of environmental and human health risk assessment, waste management, waste policy and permitting. Eoin has also got extensive experience in the preparation of air and climate assessments and reports for EIAs, particularly relating to wind energy. Eoin has wide experience in the project management of large scale infrastructural projects and brownfield developments and has routinely undertaken detailed quantitative risk assessment for the protection of controlled waters and ground gas risk assessments. Eoin holds an MSc in Environmental Engineering and is a Chartered Member of the Chartered Institute of Water and Environmental Management (CWEM) and Chartered Environmentalist (CEnv) with the Society of Environment. Michael has over seventeen years' experience in the environmental sector and had worked for the Geological Survey of Ireland and then a prominent private environmental & hydrogeological consultancy prior to joining MKO in 2014. Michael completed an MA in Environmental Management at NUI, Maynooth in 1999. Michael is a professional geologist (PGeo) and full member of IEMA (MIEMA) as well as a Chartered Environmentalist (CEnv) and also has extensive experience in the preparation of air and climate assessments and reports for EIAs, particularly relating to wind energy.

11.2 Air Quality

11.2.1 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).
- A 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.

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 PM2.5 (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 PM10) or up to five years (nitrogen dioxide, benzene) for complying with limit values, based on conditions and the assessment by the European Commission.

Table 11.1 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 11.1 Limit values of Directive 2008/50/EC, 1999/30/EC and 2000/69/EC (Source: EPA)

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

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)	Upper assessment threshold for the protection of Human Health	24 hours	75	28	Not to be exceeded more than 3 times in a calendar year	1st Jan 2005
Sulphur dioxide (SO_2)	Lower assessment threshold for the protection of human health	24 hours	50	19	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 dioxide (NO_2)	Upper assessment threshold for the protection of human health	1 hour	140	73	Not to be exceeded more than 18 times in a calendar year	1st Jan 2010
Nitrogen dioxide (NO_2)	Lower assessment threshold for the protection	1 hour	100	52	Not to be exceeded more than 18 times in a calendar year	1st Jan 2010

Pollutant	Limit Value Objective	Averaging Period	Limit Value (µg/m3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
	of human health					
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
Particulate matter 10 (PM_{10})	Upper assessment threshold for the protection of human health	24 hours	30	-	Not to be exceeded more than 7 times in a calendar year	Based on the indicative limit values for 1 January 2010
Particulate matter 10 (PM_{10})	Lower assessment threshold for the protection of human health	24 hours	20	-	Not to be exceeded more than 7 times in a calendar year	Based on the indicative limit values for 1 January 2010
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

Pollutant	Limit Value Objective	Averaging Period	Limit Value (µg/m3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
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 11.2 presents the limit and target values for ozone.

Table 11.2 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	-

AOT_{40} is a measure of the overall exposure of plants to ozone. It is the sum of the excess hourly concentrations greater than 80 g/m^3 and is expressed as g/m^3 hours.

11.2.1.1 Air Quality and Health

The Environmental Protection Agency (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 per annum. 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, carbon monoxide, benzene and lead are produced during fossil fuel-based electricity generation and traffic in various amounts, depending on the fuel and technology used. Whilst there is the potential of such emissions to be generated from the

site operations, a number of mitigation measures will be implemented at this site to reduce the impact from dust and vehicle emissions, which are discussed in Sections 11.2.4 below.

11.2.2 Air Quality Zones

The 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.

11.2.3 Existing Air Quality

The air quality in the vicinity of the proposed development site is typical of that of rural areas in the West of Ireland, i.e. Zone D. Prevailing south-westerly winds carry clean, unpolluted air from the Atlantic Ocean onto the Irish mainland. The ambient air quality monitoring carried out closest to the proposed development site is at Ennis, Co. Clare, located approximately 25 kilometres northeast of the proposed development site.

EPA air quality data is available for Ennis in the report *'Ambient Air Monitoring in Ennis 24th January 2006 to 18th April 2007'* (EPA, 2008), as detailed below. More recent data is available for Sulphur Dioxide (SO_2) and Ozone (O_3) at the Ennis monitoring station. This monitoring location lies within Zone C. Lower measurement values for all air quality parameters would be expected for the proposed development site as it lies in a rural location, within Zone D. More recent data is also available for Carbon Monoxide (CO) at the Shannon monitoring station.

The proposed replanting lands in Counties Clare, Leitrim, Sligo and Tipperary are also located within Zone D and are fully described in the Assessment of Replanting Lands report included as Appendix 4-3 of this EIAR. The report also assesses the potential effects of replanting on air quality and climate within the vicinity of the replanting lands.

11.2.3.1 Sulphur Dioxide (SO_2)

Sulphur dioxide data for the 2017 monitoring period in Ennis is presented in Table 11.3.

Table 11.3 Sulphur Dioxide Data for Ennis in 2017

Parameter	Measurement
No. of measured values	8,766
Percentage Coverage	99.1%
Maximum hourly value	54.8 µg/m^3
98 percentile for hourly values	16.6 µg/m^3
Mean hourly value	3.4 µg/m^3

During the period of monitoring there were no exceedances of the 350 µg/m^3 hourly limit for the protection of human health. As can observed from Table 11.3 the maximum hourly value recorded during the assessment period was 54.8 µg/m^3. There were two exceedances of the 50 µg/m^3 lower assessment threshold (24 hour averaging period). The directive stipulates that the lower assessment threshold should not be exceeded more than three times in the calendar year. It would be expected that SO_2 values at the proposed development site (Zone D) would be significantly lower than those recorded at the Ennis monitoring site (Zone C).

11.2.3.2 Particulate Matter (PM_{10})

Sources of particulate matter include vehicle exhaust emissions, soil and road surfaces, construction works and industrial emissions. Particulate matter (PM_{10}) data for the 2007-2008 monitoring period in Ennis is presented in Table 11.4.

The 24-hour limit value for the protection of human health (50 µg/m^3) was exceeded 30 times during the measurement period. As can be observed from Table 11.4 the maximum daily value recorded was 102.6 µg/m^3.The CAFE Directive stipulates that these assessment thresholds should not be exceeded more than 35 times in a calendar year. The upper assessment threshold was exceeded on 132 days and the lower assessment threshold was exceeded on 244 days. 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 11.4 Particulate Matter (PM_{10}) Data for Ennis January 2006 to April 2007

Parameter	Measurement
No. of days	448
No. of measured values	366
Percentage Coverage	81.7%
Maximum daily value	102.6 µg/m^3
Mean daily value	28.8 µg/m^3

11.2.3.3 Nitrogen Dioxide (NO_2)

The values for the concentrations of nitrogen dioxide recorded in Ennis from January 2006 to April 2007 are displayed in Table 11.5 below. There were five exceedances of the hourly 100 µg/m^3 lower assessment threshold. The directive stipulates that the lower assessment threshold should not be exceeded more than eighteen times in the calendar year.

The maximum hourly value recorded during the assessment period was 128.3 µg/m^3. The annual lower assessment threshold for the protection of human health was not exceeded during the assessment period.

The lower assessment threshold for the protection of vegetation was exceeded during the assessment. However, the report indicates that this limit may not be applicable to air quality monitoring in urban areas.

Table 11.5 Nitrogen Dioxide and Oxides of Nitrogen Data for Ennis January 2006 to April 2007

Parameter	Measurement
No. of measured values	7,386
Percentage Coverage	68.9%
Maximum hourly value (NO_2)	128.3 µg/m^3
99.8 percentile for hourly values (NO_2)	49.7 µg/m^3
Mean hourly value (NO_2)	131.1 µg/m^3
Mean hourly value (NO_x)	19.7 µg/m^3 NO_2

11.2.3.4 Carbon Monoxide (CO)

No measurements for carbon monoxide are provided in the EPA Ambient Air Monitoring Report for Ennis. Carbon monoxide data has been sourced from air quality monitoring carried out in Shannon from January to July 2012, as shown in Table 11.6 below. The average concentration of carbon monoxide was 0.2 mg/m^3. On no occasions were values in excess of the 10 mg limit value set out in Directives 2000/69/EC or 2008/69/EC. The carbon monoxide limit value for the protection of human health is 10,000 µg/m^3 (or 10mg/m^3).

Table 11.6 Carbon Monoxide Data for Shannon January to July 2012

Hourly Values	Result (mg/m^3)
Average	0.2
Median	0.2
98 percentile	0.4
Maximum	1.3
% Data Capture	85.6
No. of Values	3,777
Values > 10mg	0

11.2.3.5 Ozone (O_3)

The values for the concentrations of ozone recorded in Ennis from January 2006 to April 2007 are displayed in Table 11.7 below. The mean hourly concentration of ozone recorded was 54.3 µg/m^3 and on no occasions were values in excess of the 180 µg/m^3 information threshold value set for the protection of the general population. The site of the proposed development, situated approximately 25 kilometres from the monitoring site, can be expected to be similar to the monitoring site in terms of ozone.

Table 11.7 Ozone Data for Ennis January 2006 to April 2007

Parameter	Measurement
No. of measured values	9,525
Percentage Coverage	88.7%
Maximum hourly value	139.6 µg/m^3
98 percentile for hourly values	94.6 µg/m^3
Mean hourly value	54.3 µg/m^3

11.2.3.6 Dust

There are no statutory limits for dust deposition in Ireland. The German TA-Luft standard for dust deposition sets a maximum permissible emission level for dust deposition of 350 mg/m^2/day. Recommendations from the Department of the Environment, Health & Local Government[1] apply the Bergerhoff limit of 350 mg/m^2/day to the site boundary of quarries. This limit value can also be implemented with regard to dust impacts from construction activities associated with the proposed development.

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 impacts on local air quality and the relevant associated mitigation measures are presented in Sections 11.2.4.2.2 below.

11.2.4 Likely Significant Effects and Associated Mitigation Measures

11.2.4.1 'Do-Nothing' Effect

If the Proposed Development were not to proceed, the opportunity to reduce emissions of carbon dioxide, oxides of nitrogen (NO_x), and sulphur dioxide (SO_2) to the atmosphere would be lost due to the continued dependence on electricity derived from coal, oil and gas-fired power stations, rather than renewable energy sources such as the proposed wind farm. This will result in an indirect negative impact on air quality nationally, regionally and locally.

11.2.4.2 Construction Phase

11.2.4.2.1 *Exhaust Emissions*

1. Turbines and Other Infrastructure

[1] *DOEHLG (2004) Quarries and Ancillary Activities, Guidelines for Planning Authorities*

The construction of turbines, site roads 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.

2. Grid Connection

The construction of the proposed substation and associated grid connection will require the use of construction machinery, thereby giving rise to exhaust emissions. Aggregate materials for the construction of the cabling route will be sourced from the on-site borrow pits to reduce the amount of emissions associated with vehicle movements. This is a short-term slight negative impact, which will be reduced through use of the best practice mitigation measures as presented below.

3. 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.

4. Waste Disposal

Construction waste will arise on the project mainly from excavation and unavoidable construction waste including material surpluses and damaged materials and packaging waste. Waste management will be carried out in accordance with Best Practice Guidelines on the Preparation of Waste Management Plans for Construction & Demolition Projects (2006) produced by the Department of Environment, Community and Local Government (DoECLGs). The expected waste volumes generated on site are unlikely to be large enough to warrant source segregation at the wind farm site. Therefore, all wastes streams generated on site will be deposited into a single waste skip which will be covered. This waste material will be transferred to a licensed /permitted Materials Recovery Facility (MRF) by a fully licensed waste contractor where the waste will be sorted into individual waste streams for recycling, recovery or disposal. The facility will be local to the proposed development site to reduce the amount of emissions associated with vehicle movements.

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.
- When stationary, delivery and on-site vehicles will be required to turn off engines.
- Users of the site will be required to ensure that all plant and vehicles are suitably maintained to ensure that emissions of engine generated pollutants is kept to a minimum.
- The majority of aggregate materials for the construction of the Proposed Development will be obtained from borrow pits on the site of the Proposed Development. This will significantly reduce the number of delivery vehicles accessing the site, thereby reducing the amount of emissions associated with vehicle movements.
- The MRF facility will be local to the proposed development site to reduce the amount of emissions associated with vehicle movements There are two licensed waste facilities located within 30 kilometres of the proposed development.

Residual Impact

Short-term Imperceptible Negative impact.

Significance of Effects

Based on the assessment above there will be no significant effects.

11.2.4.2.2 *Dust Emissions*

1. Turbines and Other Infrastructure

The construction of turbines, site roads and other onsite infrastructure will give rise to dust emissions during the construction phase. 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.

An area of 34.11 hectares of coniferous forestry will be required to be felled as part of the wind farm development. This felling will be carried out in accordance with Forest Service guidelines (detailed in Chapter 4) and in compliance with any Felling Licence granted by the Forest Service. The potential impacts associated with replanting are assessed in the Replanting Assessment included as Appendix 4-3 of this EIAR. A further 28.2 hectares of forestry will be felled to encourage peat restoration for the proposed Hen Harrier and Peatland Enhancement Plan.

2. Grid Connection

The construction of the proposed substation and associated grid connection will give rise to localised dust emission during their construction. This is a short-term slight negative impact. Mitigation measures to reduce this impact are presented below.

3. 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 impact are presented below.

4. Borrow Pits

Development of the proposed borrow pits and the extraction of material from this location will give rise to localised dust emissions. This is a short-term moderate negative impact. Mitigation measures to reduce this impact are presented below.

Mitigation

- In periods of extended dry weather, dust suppression may be necessary along haul roads, site roads, around borrow pit areas and other infrastructure 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, borrow pit and site compounds 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.
- The transport of dry peat and spoil, that has the significant potential to generate dust, to the on-site borrow pits will be minimised. If necessary, excavated peat and spoil will be dampened prior to transport to the borrow pits.
- A Construction and Environmental Management Plan (CEMP) will be in place throughout the construction phase (see Appendix 4-4). The CEMP includes dust suppression measures.

Residual Impact

Following implementation of mitigation measures as outlined above, residual impacts of dust generation from the construction phase will have a Short-term Imperceptible Negative Impact.

Significance of Effects

Based on the assessment above there will be no significant effects.

11.2.4.3 Operational Phase

11.2.4.3.1 *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 negative effect.

Mitigation

Any vehicles or plant brought onsite during the operational phase will be maintained in good operational order that comply with the Road Traffic Acts 1961 as amended, thereby minimising any emissions that arise.

Residual Impacts

Long-term Imperceptible Negative Impact

Significance of Effects

Based on the assessment above there will be no significant effects.

11.2.4.3.2 *Air Quality*

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), sulphur dioxide (SO_2), lead (Pb), carbon monoxide (CO), benzene (C_6H_6) and ozone (O_3). 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 11.3.3 below.

Residual Impact

Long-term Significant Positive Impact

Significance of Effects

Based on the assessment above there will be a significant positive effect.

11.2.4.3.3 *Human Health*

Exposure to chemicals such as SO_2 and NO_x, Pb, benzene and O_3 are thought to be 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 effects.

11.2.4.4 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.

11.3 Climate

Climate legislation and policy is outlined in detail in Chapter 2 of this EIAR, however, a summary of the key information is provided in Section 11.3.1 below.

11.3.1 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.

11.3.1.1 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.

11.3.1.1.1 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, thirty-seven 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.

11.3.1.1.2 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.

11.3.1.1.3 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. On the 4th of March 2020, the European Commission put forward the proposal for a European climate law. This aims to establish the framework for achieving EU climate neutrality. It aims to provide a direction by setting a pathway

to climate neutrality and to this end, aims to set in legislation the EU's 2050 climate-neutrality objective. If accepted, this climate law 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.

11.3.1.1.4 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 in 2018. 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 11-8.

Table 11-8 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	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	Targets	International Progress to Date (2019)	National Relevant Policy
	countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support		
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, intergovernmental forum for negotiating the global response to climate change.*	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 on Climate Change to a goal of mobilizing 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	In 2017, greenhouse gas concentrations reached new highs, with globally averaged mole fractions of CO2 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. 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	*National Adaptation Framework* *Building on Recovery: Infrastructure and Capital Investment 2016-2021* *National Mitigation Plan* *National Biodiversity Action Plan 2017-2021* *National Policy Position on Climate Action and Low Carbon Development*

SDG	Targets	International Progress to Date (2019)	National Relevant Policy
		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.	

11.3.1.1.5 *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."*

11.3.1.1.6 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 Section 2.2.3.3 of this EIAR in Chapter 2: Background to the Proposed Development. 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.

11.3.1.1.7 *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 counties 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 and 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;
  - 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 wind farm development will help contribute towards this target.

The proposed wind farm development is compatible with the relevant provisions as set out in the Climate Action Plan 2019, relating to the harnessing of renewable energy. In summary, the proposed development will contribute the following:

- Production of 147,168 MWh of electricity which would be sufficient to supply 35,040 Irish households with electricity per year. Please refer to Section 4.3.1.6 of this EIAR.
- Helping to meet the target that 70% of our electricity needs will come from renewable sources by 2030.
- Helping to reduce carbon emissions and improving Ireland's security of energy supply.
- Provision of grid connection infrastructure to support the renewable energy output from the proposed development.

Further detail on the EU 2030 targets in noted in Chapter 2 Section 2.2.

11.3.1.1.8 Climate Action Plan 2019

The *Climate Action Plan* (DCCAE, 2019) which features 183 action plans sets out how Ireland will meet its EU targets to reduce its carbon emissions by 30% between 2021 and 2030 and lay the foundations for achieving net zero carbon emissions by 2050. The CAP sets out an ambitious course of action over the coming years to address the impacts which climate may have on Ireland's 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 have 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; and
- Changes in the distribution and time of lifecycle events of plant and animal species on land and in the oceans.

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.

Chapter 7 of the CAP details the plans surrounding electricity. Within Ireland electricity accounting for 19.3% of Irelands greenhouse gases in 2017, the following is noted:

> *"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 2017 within Ireland 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. It is expected that demand for electricity is forecast to increase by 50% above existing capacity in the next decade. Generation electricity builds of a renewable nature rather than fossil fuels has been marked as essential.

The CAP goes on to note that with regards to policy measures to date that they 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 the following targets have been set out to meet the required level of emissions by 2030:

- *"Reduce CO_2 eq. emissions from the sector by 50–55% relative to 2030 Pre-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*
  - *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. 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 CAP presents clear and unequivocal support for the provision of additional renewable energy generation, and presents yet further policy support for increased wind energy.

One of the key targets in relation to forestry is the delivery of '*..an average of 8,000 ha per annum of newly planted forest, and sustainable forest management of existing forests (21 $MtCO_2$eq. cumulative abatement)'.* Ongoing and proposed measures to deliver the target include:

- The investment of nearly €3 billion in forestry, since the late 1980s, which through ongoing sustainable forest management will contribute to delivering abatement of 21 $MtCO_2$eq over the period 2021 to 2030.
- Review of the current afforestation programme to enhance participation rates, and inform land use policy to increase the benefits for climate, the environment, and rural communities.
- Commitment by Coillte to replant or restock a total of 34,770 hectares between 2016 and 2020.
- Bord na Móna's estate extends to a little under 80,000 ha. To date a little over 18,000 ha of the cut-away and cut-over peatland has been rehabilitated and the target for 2019 is to complete a further 3,000 ha. By way of additional context, as much as 50,000ha of the overall estate is currently under consideration for a wide variety of commercial future uses of which renewable energy projects constitute the greatest proportion by far.
- Hedgerows are estimated to cover 3.9% of the Irish landscape or 660,000 km length. The total area of hedgerow and non-forest woodland patches across the landscape

could possibly represent a significant carbon sink and could potentially be used as a mitigation option.

It is noted that areas cleared of forestry for the proposed development at Cahermurphy will be replaced by replanting at alternatives sites in line with the Forest Service's published policy on granting felling licences for wind farm developments. A total of 34.11 hectares of new forestry will be replanted at alternative sites. A 'Hen harrier and Peatland Habitat Enhancement Plan' has also been prepared for the proposed development which identifies an area of 28.2 ha of forestry on which to restore peatland habitats. The proposed enhancement areas will be allowed to revert to peatland habitat which offers the potential to reduce CO_2 emissions and to re-establish the carbon sink function characteristic of natural peatlands. The proposed enhancement area will also provide additional habitat for bird species including hen harrier and other species.

11.3.1.1.9 *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".*

11.3.2 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 Shannon Airport which is located approximately 32 kilometres from the site, is the nearest weather and climate monitoring station to the proposed development site that has meteorological data recorded for the 30-year period from 1981-2010. Meteorological data recorded at Shannon over the 30-year period from 1981 - 2010 is shown in Table 11.9 overleaf. The wettest months are October and December, and April is usually the driest. July is the warmest month with an average temperature of 19.8° Celsius.

Table 11.9 Data from Met Éireann Weather Station at Shannon Airport, 1981 to 2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
TEMPERATURE (degrees Celsius)													
Mean daily max	8.8	9.2	11.1	13.3	16	18.3	19.8	19.6	17.7	14.3	11.1	9	14
Mean daily min	3.2	3.2	4.5	5.7	8.2	10.9	12.9	12.7	10.8	8.2	5.5	3.6	7.4
Mean temperature	6	6.2	7.8	9.5	12.1	14.6	16.4	16.2	14.2	11.2	8.3	6.3	10.7
Absolute max.	14.8	15.5	18.3	23.5	27.2	30.2	30.6	29.8	26.1	22.3	17.6	15.3	30.6
Absolute Min.	-11.2	-5.5	-5.8	-2.3	0.2	3.6	6.7	4.4	1.7	-2.0	-6.6	-11.4	-11.4
Mean No. of Days with Air Frost	5.3	5.1	2.1	0.7	0.0	0.0	0.0	0.0	0.0	0.5	2.3	4.8	20.8
Mean No. of Days with Ground Frost	13.7	12.6	11.0	8.3	3.3	0.3	0.0	0.1	1.2	3.8	9.5	12.5	76.3
RELATIVE HUMIDITY (%)													
Mean at 0900UTC	87.1	87	85	79.8	76.3	76.8	80	82.1	84.7	87	88.9	88.4	83.6
Mean at 1500UTC	80.5	74.6	70.5	64.4	63.3	65.1	68	68.2	69.2	75.2	80.5	83.1	71.9
SUNSHINE (Hours)													
Mean daily duration	1.6	2.3	3.2	5.1	5.8	5.2	4.5	4.5	3.9	2.9	2	1.4	3.5
Greatest daily duration	8.1	10.2	11	13.6	15.6	15.8	15.7	14.4	12.2	10.1	8.3	7.1	15.8
Mean no. of days with no sun	9.2	6.4	5.7	2.4	1.9	2	2.4	2.3	2.9	5.5	7.8	11.1	59.8
RAINFALL (mm)													
Mean monthly total	102.3	76.2	78.7	59.2	64.8	69.8	65.9	82	75.6	104.9	94.1	104	977.6
Greatest daily total	38.2	29.4	28.1	40.2	25	40.6	39.5	51	52.3	36.9	26.9	41.2	52.3
Mean num. of days with >= 0.2mm	20	16	19	16	16	15	16	18	16	20	20	19	211
Mean num. of days with >= 1.0mm	16	12	14	11	12	11	12	13	12	16	15	15	159
Mean num. of days with >= 5.0mm	8	5	5	4	4	4	4	5	4	7	6	7	63
WIND (knots)													
Mean monthly speed	10.3	10.2	10	9	8.9	8.5	8.5	8.2	8.4	9.2	9.1	9.4	9.1
Max. gust	75	80	65	62	59	51	52	55	62	71	66	83	83
Max. mean 10-minute speed	52	46	44	40	37	37	38	35	40	47	41	57	57
Mean num. of days with gales	1.7	0.9	0.8	0.3	0.2	0.1	0	0.1	0.1	0.6	0.7	1.2	6.7

WEATHER (Mean No. of Days With:)													
Snow or sleet	2.3	2.3	1.4	0.5	0	0	0	0	0	0	0.1	1.3	8
Snow lying at 0900UTC	0.6	0.1	0.1	0	0	0	0	0	0	0	0	0.1	0.9
Hail	3.6	3.3	3.4	2.2	1.2	0.1	0.1	0.1	0.3	0.9	1.1	2.4	18.6
Thunder	0.9	0.5	0.4	0.3	0.5	0.5	0.8	0.4	0.2	0.4	0.4	0.5	5.7
Fog	3.3	2	2.1	1.9	1.5	1.4	1.4	2	2.9	2.9	3.9	4.2	29.6

11.3.3 Calculating Carbon Losses and Savings from the Proposed Development

11.3.3.1 Background

In addition to the combustion of fossil fuels, greenhouse gases are also released through natural processes such as the decomposition of organic material (which is composed of carbon). Bogs and peatlands are known to store large amounts of carbon. Due to the waterlogged nature of these habitats, stored carbon is not broken down and released into the atmosphere. The construction of wind farms on bog and peat habitats may affect the natural hydrological regime, thus exposing and drying out the peat and allowing the decomposition of carbon. It is necessary therefore to demonstrate that any wind farm constructed on such sites saves more carbon than is released. The site of the proposed development is partially situated on peat habitats. For this reason, the carbon balance between the use of renewable energy and the loss of carbon stored in the peat is assessed in this section of the EIAR.

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 alive 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 ground.

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.

11.3.3.2 Methodology for Calculating Losses

A methodology was published in June 2008 by scientists at the University of Aberdeen and the Macauley Institute with support from the Rural and Environment Research and Analysis Directorate of the Scottish Government, Science Policy and Co-ordination Division. The document, '*Calculating Carbon Savings from Wind Farms on Scottish Peat Lands*', was developed to calculate the impact of wind farm developments on the soil carbon stocks held in peat. This methodology was refined and updated in 2011 based on feedback from users of the initial methodology and further research in the area. The web-based version of the carbon calculator, which supersedes the excel based versions of the tool, was released in 2016. The tool provides a transparent and easy to follow method for estimating the impacts of wind farms on the carbon dynamics of peatlands. Previously guidance produced by Scottish Natural Heritage in 2003 had been widely employed to determine carbon payback in the absence of any more detailed methods.

Although the loss of carbon fixing potential from plants on peat land is not substantial, it is nonetheless calculated for areas from which peat is removed and the areas affected by drainage. This calculation takes account of the annual gains due to the carbon fixing potential of the peat land and the time required for any habitat restoration. The carbon sequestered in the peat itself represents a much more substantial potential source of carbon loss. During wind farm construction, carbon is lost as a result of peat excavation and peat drainage. The amount of carbon lost is estimated using default values from the Intergovernmental Panel on Climate Change (IPCC, 1997) as well as by more site-specific equations derived from the scientific literature. Carbon gains due to habitat improvement and site restoration are calculated in a similar fashion.

Peatlands are essentially unbalanced systems. When flooded, peat soils emit less carbon dioxide but more methane than when drained. In waterlogged soils, carbon dioxide emissions are usually exceeded by plant fixation, so the net exchange of carbon with the atmosphere is negative and soil carbon stocks increase. When soils are aerated, carbon emissions usually exceed plant fixation, so the net exchange of carbon with the atmosphere is positive. In order to calculate the carbon emissions resulting from the removal or drainage of the peat, the Macauley Institute method accounts for emissions occurring if the peat had been left in-situ, and subtracts these from the emissions occurring after removal and drainage.

The Macauley Institute methodology states that the total volume of peat impacted by the construction of the wind farm is strongly correlated to the extent of the peatland affected by drainage at the site.

The drainage of peat soils leads to continual loss of soil carbon until a new steady state is reached, when inputs are approximately equal to losses. For peats, this steady state approximates 0% carbon, so 100% carbon loss from drained peats is assumed if the site is not restored after decommissioning of the wind farm. The amount of carbon lost is calculated on the basis of the annual emissions of methane and carbon dioxide, the area of drained peat, and the time until the site is restored. In the case of the proposed wind farm site, the model has been prepared on the basis of two scenarios, one where restoration of the wind farm areas will occur on decommissioning, and another where restoration will not occur.

The effects of drainage may also reduce dissolved and particulate organic carbon retention within the peat. Losses of carbon dioxide due to leaching of dissolved and particulate organic carbon are calculated as a proportion of the gaseous losses of carbon from the peat. The Macauley Institute method assumes that published good practice is employed in relation to avoiding the risk of peat landslides. This is certainly the case in respect of the proposed development, which has been the subject of a peat stability risk assessment, as described in the *Geotechnical Peat Stability Assessment Report* in Appendix 7-1 of this EIAR. Therefore, this potentially large carbon loss pathway is omitted from the calculations.

Clearfelling of existing forestry surrounding turbine locations may often be necessary to avoid reductions in the wind energy yield of the wind farm proposal and to protect local bat populations. Forestry may be felled earlier than originally planned due to the wind farm development, so limiting the nature and longevity of the resulting timber produced. If a forestry plantation was due to be felled with no plan to replant, the effect of the land use change is not attributable to the wind farm development and is omitted from the calculation. If, however, the forestry is felled for the development, the effects are judged to be attributable to the wind farm development. Carbon losses as a result of felling are calculated from the area to be felled, the average carbon sequestered annually, and the lifetime of the wind farm. It is also noted that there will permanent removal of forestry required for the Hen Harrier enhancement areas which has also been included in the carbon calculation. Please refer to Appendix 8-8 –Hen Harrier and Peatland Habitat Enhancement Plan. However, these areas will be allowed to revert to peatland habitat which offers the potential to reduce CO_2 emissions and to re-establish the carbon sink function characteristic of natural peatlands.

There will be minor releases of carbon dioxide from excavating peat which will also be captured in the carbon calculations below. Alterations in soil carbon levels following felling are calculated using the equations for drainage and site restoration already described.

11.3.3.3 Calculating Carbon Losses and Savings

11.3.3.3.1 *Carbon Losses*

The Scottish Government on-line carbon calculator was used to assess the impacts of the proposed wind farm in terms of potential carbon losses and savings taking into account peat removal, drainage, habitat improvement, forestry felling and site restoration.

A copy of the outputs is provided as Appendix 11-1 of this EIAR. Where available and relevant, site-specific information was inserted into the worksheet. Otherwise, default values were used.

The worksheet was pre-loaded with information specific to the CO_2 emissions from the United Kingdom's electricity generation plant, which is used to calculate emissions savings from proposed wind farm projects in the UK. Similar data to that used in the worksheet to calculate the CO_2 emissions from the UK electricity generation plant, was not available for the Irish electricity generation plant, and so the CO_2 emissions savings from the proposed wind farm development were calculated separately from the worksheet.

The main CO_2 losses due to the proposed wind farm development are summarised in Table 11.10.

Table 11.10 CO_2 losses from the Proposed Development

Origin of Losses	CO_2 Losses (tonnes CO_2 equivalent)	
	Expected	Maximum
Losses due to turbine life (e.g. due to production, transportation, erection, operation and dismantling of the wind farm)	41,437	41,595
Losses due to backup from fossil fuel mix of electricity generation	28,382	28,382
Losses due to reduced carbon fixing potential	1,785	3,454
Losses due to leaching of dissolved and particulate organic carbon	0	89
Losses from soil organic matter (CO2 loss from removed and drained peat). The model includes for peat losses at the proposed wind farm site and grid connection route.	5,742	28,241
Losses due to felling forestry for wind farm and grid route.	13,571	14,550
Losses due to felling forestry for Enhancement Plan	11,104	11,905
Total	102,021	128,216

The worksheet model calculates that the proposed development will give rise to 102,021 tonnes of CO_2 equivalent losses over its 30-year life. Of this total figure, the proposed wind turbines directly account for 41,437 tonnes, or 41%. Losses due to backup account for 28,382 tonnes, or 28%. Losses from soil organic matter, reduced carbon fixing potential and the felling of forestry accounting for the remaining 32% or 32,202 tonnes. The figure of 32,202 tonnes of CO_2 arising from ground activities associated with the proposed development is calculated based on the entire development footprint being "Acid Bog",

as this is one of only two choices the model allows (the other being Fen). The habitat that will be impacted by the development footprint comprises predominantly commercial forestry rather than the acid bog assumed by the model that gives rise to the 32,202 tonnes and therefore the actual CO_2 losses are expected to be lower than this value.

The figures discussed above are based on the assumption that the hydrology of the site and habitats within the site are restored on decommissioning of the proposed wind farm after its expected 30-year useful life. As a worst-case scenario, the model was also used to calculate the CO_2 losses from the wind farm if the hydrology and habitats of the site were not to be restored, as may be the case if the turbines were replaced with newer models, rather than decommissioned entirely and taking account of the future peat extraction activities. This worst-case scenario would increase the expected carbon losses by an additional 26,195 tonnes, or by 26% to 128,216 tonnes. Any failure to restore the site habitats or hydrology for the reasons outlined above would be further offset by the carbon-neutral renewable energy that the new turbines would generate.

11.3.3.3.2 Carbon Savings

According to the model described above, the proposed wind farm development will give rise to total losses of 102,021 tonnes of carbon dioxide.

A simple formula can be used to calculate carbon dioxide emissions reductions resulting from the generation of electricity from wind power rather than from carbon-based fuels such as peat, coal, gas and oil. The formula is:

$$CO_2 \text{ (in tonnes)} = \frac{(A \times B \times C \times D)}{1000}$$

where: A = ... The rated capacity of the wind energy development in MW

B = ... The capacity or load factor, which takes into account the intermittent nature of the wind, the availability of wind turbines and array losses etc.

C = ... The number of hours in a year

D = ... Carbon load in grams per kWh (kilowatt hour) of electricity generated and distributed via the national grid.

For the purposes of this calculation, the rated capacity of the proposed wind farm is assumed to be approximately 48 MW.

A load factor of 0.35 (or 35%) has been used for the proposed development.

The number of hours in a year is 8,760.

The most recent data for the carbon load of electricity generated in Ireland is for 2017, and was published in Sustainable Energy Authority Ireland's (SEAI) December 2018 report, '*Energy in Ireland, 2018 Report.*' The emission factor for electricity in Ireland in 2017 was 436.6 g CO_2/kWh.

The calculation for carbon savings is therefore as follows:

$$CO2 \text{ (in tonnes)} = \frac{(48 \times 0.35 \times 8{,}760 \times 436.6)}{1000}$$

$$= 64{,}254 \text{ tonnes per annum}$$

Based on this calculation, approximately 64,254 tonnes of carbon dioxide will be displaced per annum from the largely carbon-based traditional energy mix by the proposed wind farm. Over the proposed thirty-year lifetime of the wind farm, therefore, 1,927,606 tonnes of carbon dioxide will be displaced from traditional carbon-based electricity generation.

As noted previously areas cleared of forestry for the proposed development at Cahermurphy will be replaced by replanting at alternatives sites. A total of 34.11 hectares of new forestry will be replanted at alternative sites to compensate the loss of forestry at the development site. Given that losses due to felling forestry account for 13,507 tonnes of CO_2, it has been assumed for the purposes of this calculation that the same quantity of CO_2 can be saved by replanting forestry at alternative sites.

In total, it is estimated that **1,941,113** tonnes of carbon dioxide will be displaced over the proposed thirty-year lifetime of the wind farm.

Based on the Scottish Government carbon calculator as presented above 102,021 tonnes of CO_2 will be lost to the atmosphere due to changes in the peat environment and due to the construction and operation of the proposed development. This represents 5.3% of the total amount of carbon dioxide emissions that will be offset by the proposed wind farm project. The 102,021 tonnes of CO_2 that will be lost to the atmosphere due to changes in the peat environment and due to the construction and operation of the proposed development will be offset by the proposed development in approximately **19 months** of operation.

11.3.4 Likely Significant Effects and Associated Mitigation Measures

11.3.4.1 'Do-Nothing' Effect

If the Proposed Development were not to proceed, 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) from fossil fuels 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.

11.3.4.2 Construction Phase

11.3.4.2.1 *Greenhouse Gas Emissions*

1. Turbines and Other Infrastructure

The construction of turbine bases and hardstands, site roads 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 activities. This potential impact will be slight only, 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.

2. Grid Connection

The construction of the proposed substation and associated grid connection will require the use of construction machinery, thereby 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.

3. 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.
- The majority of aggregate materials for the construction of the proposed wind farm will be obtained from the three proposed borrow pits on the site of the Proposed Development. This will significantly reduce the number of delivery vehicles accessing the site, thereby reducing the amount of emissions associated with vehicle movements.

Residual Impacts

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 effects.

11.3.4.3 Operational Phase

11.3.4.3.1 *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 11.10 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 on climate.

Some potential long-term slight negative impacts that may occur during the operational phase of the Proposed Development are the release of small amounts of carbon dioxide to the atmosphere due to the potential alteration to the drainage of the site and the removal of carbon fixing vegetation. These impacts will be slight and will be nullified by the quantity of carbon dioxide that will be displaced by the Proposed Development and by the design and layout of the development which has ensured the utilisation of as much of the existing roads on site as possible to gain access to the proposed turbine locations and minimise the construction of additional roads through peat-based habitats.

Residual Impacts

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 no significant effects.

11.3.4.4 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.

11.4 Cumulative Assessment

Potential cumulative effects on air quality and climate between the Proposed Development and other developments in the vicinity were also considered as part of this assessment. The developments considered as part of the cumulative effect assessment are described in Section 2.4 of this EIAR. The forestry works (felling/planting) associated with the proposed development will be carried out under the relevant guidance and under licence from the Forestry Service and full details are set out in Section 4.3.10 of this EIAR in conjunction with the replanting assessment included as Appendix 4-3. No projects or plans were identified that would be incompatible with the proposed replanting or felling to give rise to significant cumulative impacts.

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 the construction phase of other developments within 20 kilometres of the wind farm site 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 Section 11.2.4.2 and Section 11.3.4.2 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 proposed wind farm. Exhaust 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 developments on air quality and climate.

The nature of the Proposed Development and other wind energy developments within 20 kilometres are such that, once operational, they will have a cumulative long-term, significant, positive effect on the air quality and climate.

The replanting lands are located in counties Roscommon, Clare, Galway and Cavan and therefore are not likely to contribute to potential cumulative impacts with the proposed wind farm development in terms of impacts on air and climate. The potential direct, indirect and cumulative impacts of replanting lands on air and climate has been assessed in the Section 10 of Appendix 4-3 Assessment of Forestry Replacement Lands.

12. NOISE AND VIBRATION

12.1 Introduction

12.1.1 Background & Objectives

This chapter of the EIAR describes the assessment undertaken of the potential noise and vibration impacts associated the proposed Cahermurphy Two Wind Farm Development (the 'Proposed Development'). The Proposed Development comprises up to 10 no. wind turbines with a maximum overall ground level to blade tip height of up to 170 metres, an electricity substation, construction compound and all ancillary infrastructure including the grid connection to the National Grid. A full description of the proposed development is provided in Chapter 4 of this EIAR.

There are 100 no. noise sensitive locations within 1.2 km of the proposed turbine locations. The nearest noise sensitive location (NSL) is located approximately 700m to the nearest proposed turbine location (i.e. Location H001 from proposed turbine T6). The next nearest NSLs are H075 and H092, which are located approximately 702m to the nearest proposed turbine locations at T01 and T10 respectively.

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

Existing, under construction, permitted and proposed wind farm developments have been identified in the wider study area and the cumulative impact of these developments has been considered in this assessment. Other developments that did not significantly contribute to cumulative noise levels surrounding the site were excluded from the assessment in line with guidance set out in the IOA Good Practice Guide. Further details on each of these developments is provided in Chapter 2 of this EIAR.

12.1.2 Statement of Authority

This chapter of the EIAR has been prepared by the following staff of AWN Consulting Ltd:

Mike Simms
Mike Simms (Senior Acoustic Consultant) holds a BE and MEngSc in Mechanical Engineering, and is a member of the Institute of Acoustics and of the Institution of Engineering and Technology. Mike has worked in the field of acoustics for over 19 years. He has extensive experience in all aspects of environmental surveying, noise modelling and impact assessment for various sectors including, wind energy, industrial, commercial and residential.

Dermot Blunnie
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.

12.2 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 has to be 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 12-1.

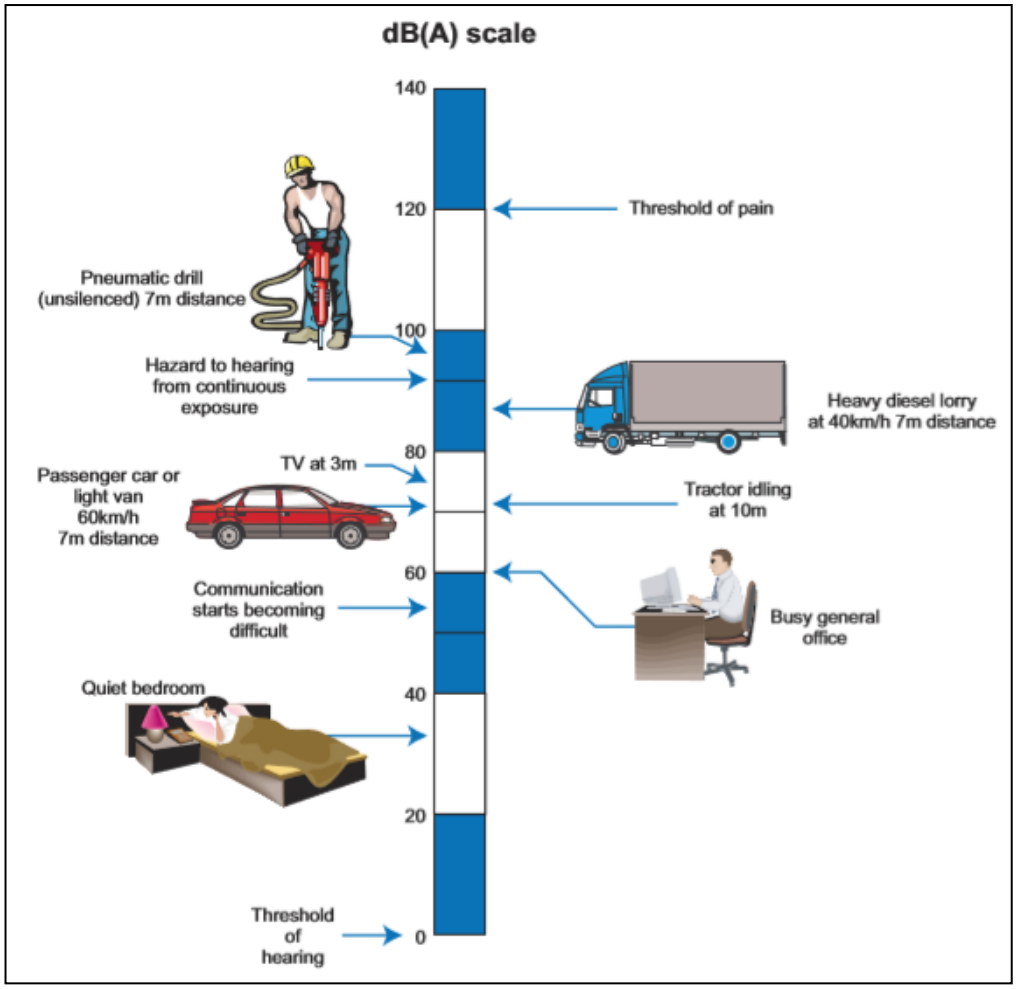

Figure 12-1 The level of typical common sounds on the dB(A) scale (NRA Guidelines for the Treatment of Noise and Vibration in National Road Schemes, 2004)

For a glossary of terms used in this chapter please refer to Appendix 12-1.

12.3 Methodology

The assessment of impacts has been undertaken with reference to the most appropriate guidance documents relating to noise and vibration for both the operational and construction phases of the proposed development, which are set out within the relevant sections of this chapter.

In addition to the specific guidance documents mentioned above, the following guidelines were considered and consulted for the purposes of preparing this chapter:

- EPA Guidelines on the Information to be contained in Environmental Impact Statements, (EPA, 2002);
- EPA Advice Notes on Current Practice (in the preparation of Environmental Impact Statements), (EPA, 2003);
- EPA Guidelines on the Information to be contained in Environmental Impact Assessment Reports Draft August 2017 (EPA, 2017); and
- EPA Advice Notes for Preparing Environmental Impact Statements, (Draft, September 2015).

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 noise and vibration environment;
- Characterise the proposed development;
- Predict the noise and vibration impact and cumulative impacts associated with the proposed development, and;
- 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.

12.3.1.1 Noise Model

A series of computer-based prediction models have been prepared to quantify the noise level associated with the operation of the proposed development. This section discusses the methodology for the noise modelling process.

12.3.1.1.1 *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).

12.3.1.1.2 *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 12-2.

Turbine Details

Table 12-1 details the co-ordinates of the 10 no. proposed turbines that are being considered in this assessment.

Table 12-1 Proposed Cahermurphy Two Turbine Co-ordinates

Turbine Ref.	Co-ordinates (ITM)	
	Easting	Northing
T01	507,384	669,377
T02	507,942	669,771
T03	508,531	669,910
T04	507,794	669,044
T05	508,291	669,400
T06	508,921	669,600
T07	508,219	668,683
T08	508,998	668,990
T09	508,312	668,186
T10	509,012	668,538

For the purposes of this assessment, consideration has been given to several potential turbine technologies that have been identified as being suitable for the Proposed Development. The actual turbine to be installed on the site will be the subject of a competitive tender process and could include other turbines models not currently available. Regardless of the make or model of the turbine eventually selected for installation on site, the noise emission of the turbine shall be no greater than that used for the purposes of this assessment to ensure that the required noise limits are achieved at all noise sensitive locations.

Sound power levels (L_{WA}) have been supplied for the various turbines under consideration. These levels have been reviewed and an envelope method used whereby the worst case, i.e. highest noise levels, for the proposed turbine models have been selected and input into the noise model. For the purposes of this assessment, a turbine hub height of 105m above ground has been used for noise calculations presented here. This in full accordance with the guidance, where the noise point source is modelled as being at the centre of the most significant noise-generating elements of the wind turbine, i.e. the nacelle itself and the wind turbine blades.

Table 12-2 details the noise spectra used for noise modelling purposes for the proposed Cahermurphy Two Wind Farm development. As outlined, appropriate guidance is couched in terms of a LA90 criterion. The turbine sound power levels provided are referenced in terms of the LAeq parameter. Best practice guidance contained within the Institute of Acoustics guidance document, *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* (2013) (hereafter called IoA GPG), states that "LA90 levels should be determined from calculated LAeq 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.

Table 12-2 Sound Power Level Spectra Used for Prediction Model – Cahermurphy Two Wind Farm

Wind Speed (m/s)	Octave Bank Centre Frequency (Hz)								dB LWA
	63	125	250	500	1000	2000	4000	8000	
4	78.0	84.8	89.1	91.7	91.4	88.3	84.5	76.2	97.0
5	82.2	89.2	93.8	96.3	96.0	93.1	88.8	79.6	101.6
6	86.4	93.4	97.5	99.8	99.6	97.3	93.0	84.1	105.4
7	87.8	94.8	98.6	100.6	100.4	98.7	94.4	85.2	106.4
≥8	88.9	94.6	98.3	100.6	100.4	100.0	97.7	87.1	106.9

A list of existing, permitted and proposed windfarm developments in proximity to the subject site was provided at the early stages of the assessment process. A noise modelling exercise was carried out to address the potential for cumulative impacts associated with other windfarms in conjunction with the Cahermurphy development. Other developments that did not significantly contribute to cumulative noise levels surrounding the site were excluded from the assessment in line with guidance set out in the IOA Good Practice Guide.

In accordance with the guidance in IoA GPG Section 5, the following wind farms were included in the cumulative noise model: the neighbouring Cahermurphy One wind farm which is located to the east of the proposed development site and the Kiltumper wind farm, under construction to the southeast, at approximately 2.5 km distance. Although the Kiltumper wind farm is a sufficient distance from the proposed development and that cumulative impacts are unlikely, it has been included in the assessment in order to demonstrate that there are no significant impacts.

Table 12-3 and Table 12-4 detail the noise data used for noise modelling purposes for the Cahermurphy One and Kiltumper developments respectively.

Table 12-3 Sound Power Level Spectra Used for Prediction Model – Cahermurphy One Wind Farm

Wind Speed (m/s)	Octave Bank Centre Frequency (Hz)								dB LWA
	63	125	250	500	1000	2000	4000	8000	
4	78.0	86.2	86.3	88.1	90.6	91.2	89.4	78.9	97.0
5	80.5	88.7	88.8	90.6	93.1	93.7	91.9	81.4	99.5
6	83.0	91.2	91.3	93.1	95.6	96.2	94.4	83.9	102.0
7	84.3	92.5	92.6	94.4	96.9	97.5	95.7	85.2	103.3
8	85.2	93.4	93.5	95.3	97.8	98.4	96.6	86.1	104.2
≥9	86.0	94.2	94.3	96.1	98.6	99.2	97.4	86.9	105.0

Table 12-4 Sound Power Level Spectra Used for Prediction Model – Kiltumper Wind Farm

Wind Speed (m/s)	Octave Bank Centre Frequency (Hz)								dB LWA
	63	125	250	500	1000	2000	4000	8000	
4	74.5	82.5	82.2	84.8	86.6	81.7	69.4	61.3	91.1
5	77.5	85.5	85.2	87.8	89.6	84.7	72.4	64.3	94.1
6	83.1	91.1	90.8	93.4	95.2	90.3	78.0	69.9	99.7
7	85.0	93.0	92.7	95.3	97.1	92.2	79.9	71.8	101.6
8	86.9	94.9	94.6	97.2	99.0	94.1	81.8	73.7	103.5
≥9	87.9	95.9	95.6	98.2	100.0	95.1	82.8	74.7	104.5

The manufacturer's turbine sound power levels in Table 12-2, Table 12-3 and Table 12-4 are based on measurements in terms of the LAeq acoustic parameter1. In accordance with best practice guidance contained within the Institute of Acoustics Good Practice Guide (IoA GPG), an allowance for uncertainty in the measurement of turbine source levels of +2dB is added to all turbine sound power levels presented in the tables above.

Moreover, as explained below in Section 12.4.2.1, appropriate guidance is couched in terms of a L_{A90} criterion. Best practice guidance in the IoA GPG states that "L_{A90} levels should be determined from calculated LAeq levels by subtraction of 2 dB". Therefore, a 2dB reduction has been applied to the noise model output. All predicted noise levels in this chapter are presented in terms of L_{A90}, i.e. this reduction of 2dB is included in the values presented.

Finally, best practice specifies that should any tonal component be present, a penalty shall be added to the predicted noise levels. The level of this penalty is described in ETSU-R-97[2], and is related to the level by which any tonal components exceed audibility. For the purposes of 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.

12.4 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.

12.4.1 Construction Phase

12.4.1.1 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 construction works and may consider noise limits at their discretion.

[1] *For details, see IEC 61400 Wind turbine generator systems – Part 11: Acoustic noise measurement techniques.*
[2] *UK Department of Trade and Industry: ETSU-R-97 The assessment of rating of Noise from wind farms, 1996*

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 (construction noise only), indicates a potential significant noise impact is associated with the construction activities.

Table 12-5 sets out the values which, when exceeded, potentially signify a significant effect at the facades of residential receptors as recommended by BS 5228 – 1. These levels relate to construction noise only.

Table 12-5 Example Threshold of Potential Significant Effect at Dwellings

Assessment category and threshold value period (T)	Threshold values, $L_{Aeq,T}$ 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.

The following 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, as a precautionary approach, all properties will be afforded a Category A designation.

See Section 12.6.2 for the detailed assessment in relation to this site. 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.

12.4.1.2 Additional Vehicular Activity on Public Roads

There are no specific guidelines or limits relating to traffic related sources along the local or surrounding roads. Given that traffic from the development will make use of existing roads already carrying traffic volumes, it is appropriate to assess the calculated increase in traffic noise levels that will arise because of vehicular movements associated with the development. To assist with the interpretation of the noise associated with additional vehicular traffic on public roads, Table 12-6, adapted from

Design Manual for Roads and Bridges (DMRB), Highways England Company Limited, Transport Scotland, The Welsh Government and The Department for Regional Development (Northern Ireland), 2011, offers guidance as to the likely impact in the long-term associated with any change in traffic noise level.

Table 12-6 Likely Impacts Associated with Change in Traffic Noise Level (Source DMRB, 2011)

Change in Sound Level	Magnitude of Impact	EPA Significance of Effect
0	No Change	Imperceptible
0.1 – 0.9	Negligible	Not significant
1.0 – 2.9	Minor	Slight/Moderate
3.0 – 4.9	Moderate	Significant
5+	Major	Very Significant

The guidance outlined in Table 12-6 will be used to assess the predicted increases in traffic levels on public roads associated with the construction of the proposed development. Where an impact is identified due to the change in traffic noise level, reference will be made to the overall predicted noise level from construction traffic in the context of the construction noise criteria outlined in Section Construction Noise12.4.1.1.

12.4.1.3 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 (1993); and
- BS 5228 – Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration (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 12-7.

Table 12-7 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

12.4.2 Operational Phase

12.4.2.1 Noise

The noise assessment summarised in the following sections has been based on guidance in relation to acceptable levels of noise from wind farms as contained in the document "*Wind Energy Development Guidelines"* 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 & 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.

12.4.2.1.1 *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 can 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:

- Identify an appropriate absolute limit level for quiet daytime environments of less than 30 dB $L_{A90,10min}$;
- 45 dB LA90,10min 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 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 12.6.3.1.

12.4.2.1.2 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 guidance document 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.

12.4.2.1.3 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.

Reference has been made to the IoA GPG for guidance on the methodology for the background noise survey and operation impact assessment for wind turbine noise.

12.4.2.1.4 Future Potential Guidance Change

In December 2019, the Draft Revised Wind Energy Development Guidelines December 2019 were published for consultation and therefore have yet to be finalised. It is important to note that as part of the public consultation a number of concerns in relation to the proposed approach have been expressed by various parties and it is the opinion of the authors' of this assessment that the document does not outline a best practice approach in terms of the assessment of wind turbine noise. Specific concerns expressed by a cross party group of interested professionals can be reviewed at:

> *https://www.ioa.org.uk/wind-energy-development-guidelines-wedg-consultation-irish-department-housing-planning-community-and*

The following statement is of note from the above submission:

> *"a number of acousticians working in the field have raised serious concerns over the significant amount of technical errors, ambiguities and inconsistencies in the content of the draft WEDG and these were highlighted during the consultation process by a group of acousticians"*

Therefore, in line with best practice, which includes ESTU and IoA methodologies as described above the assessment presented in the EIAR is based on the current best practice guidance outlined in Section 5.6 of the Wind Energy Development Guidelines for Planning Authorities, 2006.

12.4.2.1.5 World Health Organisation (WHO) Noise Guidelines for the European Region

The 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 World Health Organisation (WHO) Environmental Noise Guidelines for the European Region that was published in October 2018 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 $L_{den,}$ as wind turbine noise above this level is associated with adverse health effects.

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

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

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

The WHO Environmental Noise Guidelines aim to support the legislation and policy-making process on local, national and international level, thus shall be considered by Irish policy makers for any future revisions of Irish National Guidelines.

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 L_{den} is converted from original sound pressure level values. The conversion requires, as variable, the statistical distribution of annual wind speed at a particular height, which depends on the type of wind turbine and meteorological conditions at a particular geographical location. Such input variables may not be directly applicable for use in other sites. They are sometimes used without specific validation for a particular area, however, because of practical limitations or lack of data and resources. This can lead to increased uncertainty in the assessment of the relationship between wind turbine noise exposure and health outcomes. Based on all these factors, it may be concluded that the acoustical description of wind turbine noise by means of L_{den} or L_{night} may be a poor characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes...

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

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

12.4.2.2 Special Characteristics of Turbine Noise

12.4.2.2.1 *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, 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.

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 "*Low 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."*

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3 *EPA South Australia, 2013, Wind farms https://www.epa.sa.gov.au/files/477912_infrasound.pdf*

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 Emissions" November 2013*

12.4.2.2.2 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.

'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.

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."

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 long-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.

12.4.2.3 Comments on Human Health Impacts

12.4.2.3.1 *The National Health & 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."

12.4.2.3.2 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.

12.4.2.3.3 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.

12.4.2.3.4 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."

12.4.2.3.5 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

[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

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."*

The report concluded that living near wind farms does not result in the worsening of the quality of life in that region.

12.4.2.4 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 NSLs to any of the turbines in the proposed development the level 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.

12.4.2.5 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), Draft, August 2017*. Details of the methodology for describing the significant of the effects are provided in 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.

12.5 Receiving Environment

This stage of the assessment was 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 five locations in the surrounding area.

All measurement data collected during the background noise surveys has been carried out in accordance with the IoA GPG and the accompanying Supplementary Guidance Note 1: Data Collection (2014).

12.5.1 Choice of Unattended Measurement Locations

The noise monitoring locations were identified by preparing a preliminary 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 line with current best practice guidance outlined in the IoA GPG. The selection of the noise monitoring locations was informed by site visits and supplemented by reviewing of aerial images of the study area and other online sources of information (e.g. Google Earth).

The selected locations for the noise monitoring are outlined in the following sections. Coordinates for the noise monitoring locations are detailed in Table 12-8 and illustrated in Figure 12-2.

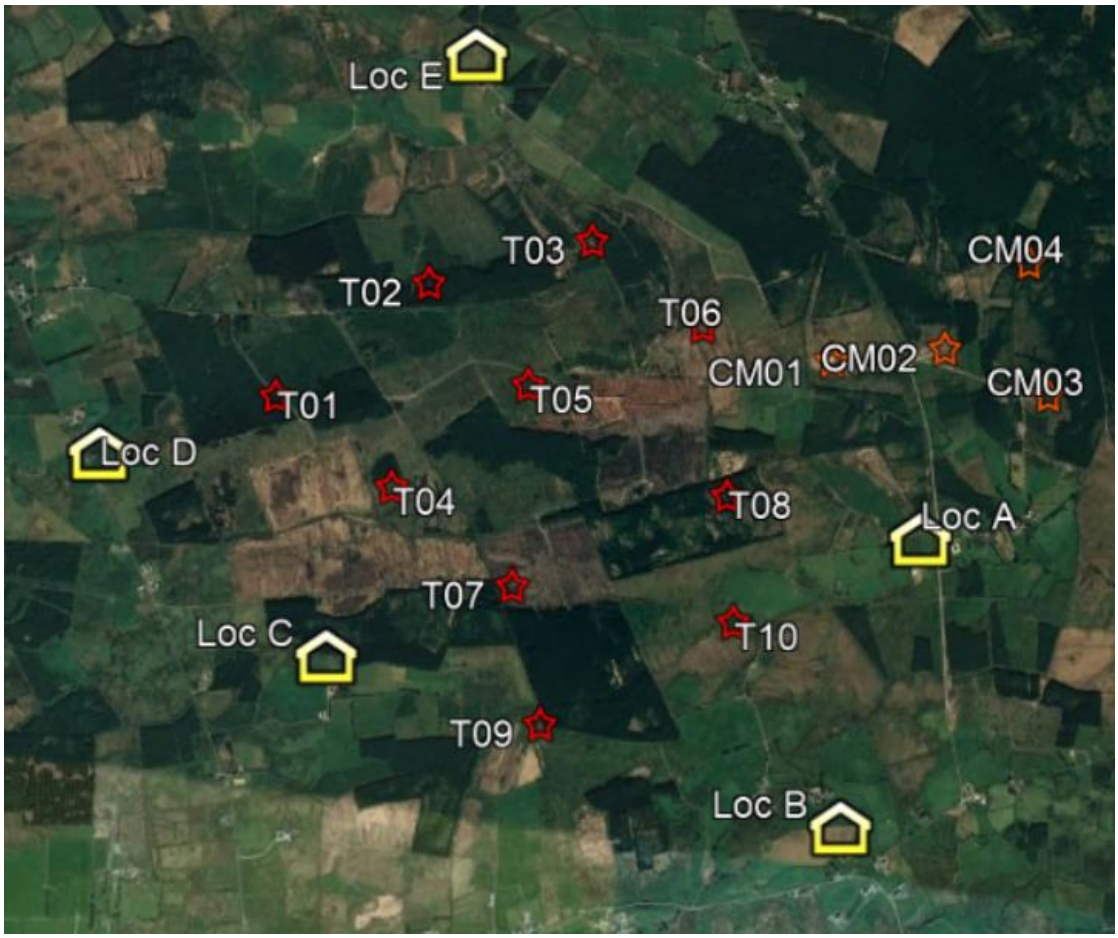


Figure 12-2 Indicative measurement locations (A, B, C, D, and E).

Table 12-8 Measurement Location Coordinates

Location	Coordinates – Irish Grid (ITM)	
	Easting	Northing
A (H029)	509684	668702
B (H016)	509379	667675
C (H023)	507544	668324
D (H075)	506744	669064
E (H028)	508122	670462

Significant noise sources in this area were noted to be distant traffic movements, activity in and around the residences and wind generated noise from local foliage and other typical anthropogenic sources typically found in such rural settings.

There were no perceptible sources of vibration noted at any of the survey locations.

Plate 12-1 to Plate 12-7 illustrate the installed noise monitoring kits. In the descriptions that follow, all distances are approximate.

The noise meter at Location A was positioned approximately 20m south-west of the dwelling, 15m west of a farmyard shed, 65m from the local road and 1.5m above the low level vegetation in the immediate area.

Plate 12-1 Location A (H029)

Location B was positioned 10m southwest of the dwelling, 30m northwest of a strong hedgerow and 65m from the local road and 1.5m above the low-level vegetation in the immediate area.

Plate 12-2 Location B (H016)

On 20 August, the meter was moved to an alternate equivalent location to allow the use of the field for cattle. This small change in the position of the meter did not have a significant effect on the measured noise levels.

Plate 12-3 Location B (H016) – second location

Location C was positioned 15m west of the dwelling and 1.5m above the low-level vegetation in the immediate area.

Plate 12-4 Location C (H023)

On 20 August, the meter was moved to an alternate equivalent location to allow the use of the field for cattle.

Plate 12-5 Location C (H023) – second location

Location D was positioned on a lawn at 15m to the south east of the dwelling and 10m from the local road edge and 1.5m above the surrounding lawn.

Plate 12-6 Location D (H075)

Location E was positioned in grassland at 20m dwelling and 20m from the local road edge and 1.5m above the surrounding grassland.

Plate 12-7 Location E (H028)

12.5.2 Measurement Periods

Noise measurements were conducted at each of the monitoring locations over the periods outlined in Table 12-9.

Table 12-9 Measurement Periods

Location	Start Date	End Date
A (H029)	26 July 2019	30 August 2019
B (H016)	26 July 2019	30 August 2019
C (H023)	26 July 2019	30 August 2019
D (H075)	26 July 2019	30 August 2019
E (H028)	26 July 2019	30 August 2019

A variety of wind speed and weather conditions were encountered over the survey periods in question. Figure 12-3 illustrates the distributions of wind speed and wind direction standardised to 10 metre height over the survey period detailed in Table 12-9.

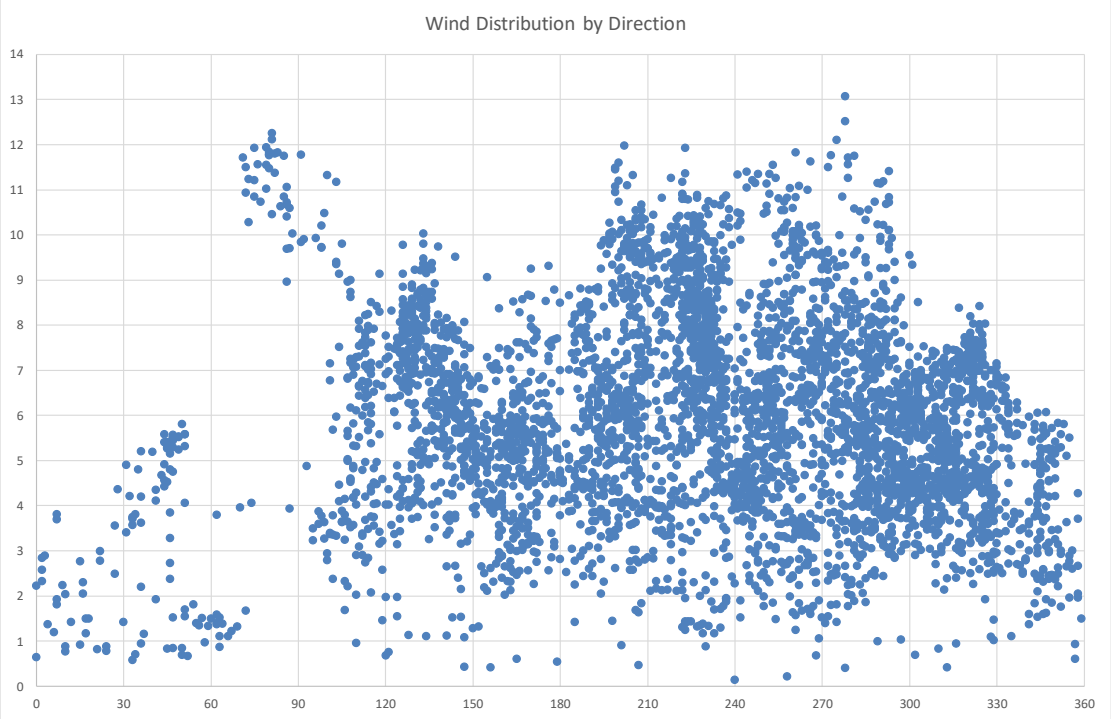


Figure 12-3 Distributions of Wind Speeds and Directions Over the Survey Period

12.5.3 Personnel and Instrumentation

AWN Consulting installed and removed the noise monitors at all locations. Battery checks and meter calibrations were carried out part-way through the survey periods. The following instrumentation was used at the various locations:

Table 12-10 Instrumentation Details

Location	Equipment	Serial Number
A (H029)	RION – NL-52	186667

Location	Equipment	Serial Number
B (H016)	RION – NL-52	186668
C (H023)	RION – NL-52	186669
D (H075)	RION – NL-52	186671
E (H028)	RION – NL-52	586944

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. Relevant calibration certificates are presented in Appendix 12.3.

Rain fall was monitored and logged using a Texas Instruments TR-525 console and a data logger that was installed on-site for the duration of the surveys. This allows for the identification of periods of rain fall to allow for the removal sample periods affect by rainfall from the noise monitoring data sets in line with best practice when calculating the prevailing background noise levels.

Wind data was measured at a meteorological mast located within the site of the proposed development and was supplied to AWN for data analysis.

12.5.4 Procedure

Measurements were conducted at five locations over the survey periods outlined in Table 12-9. Data samples for all measurements (noise, rainfall and wind) were logged continuously at 10-minute interval periods 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.

12.5.5 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 90m and 75m heights have been corrected to a height of 105m (i.e. the assumed hub height for this assessment) in accordance with Method B 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 the following sections of this chapter should be understood to be the 10m height standardised wind speed reference unless otherwise stated.

12.5.6 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*.

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.

In accordance with the guidance, noise from existing operational windfarms must not form part of the background noise. The data sets collected at all locations have been directionally filtered to exclude periods where the measurement locations were downwind of Kiltumper Wind Farm. As such, the lowest background noise conditions are captured to provide a worst-case assessment. Cahermurphy One had not yet been constructed at the time of the noise survey.

12.5.7 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 discussed above. Observations made on site during installation, interim visits and collection are presented below for each monitoring location. Site visits were carried out during the morning and afternoon time and therefore no observations were made during night-time periods.

12.5.7.1 Location A (H029)

12.5.7.1.1 *Daytime Quiet Periods*

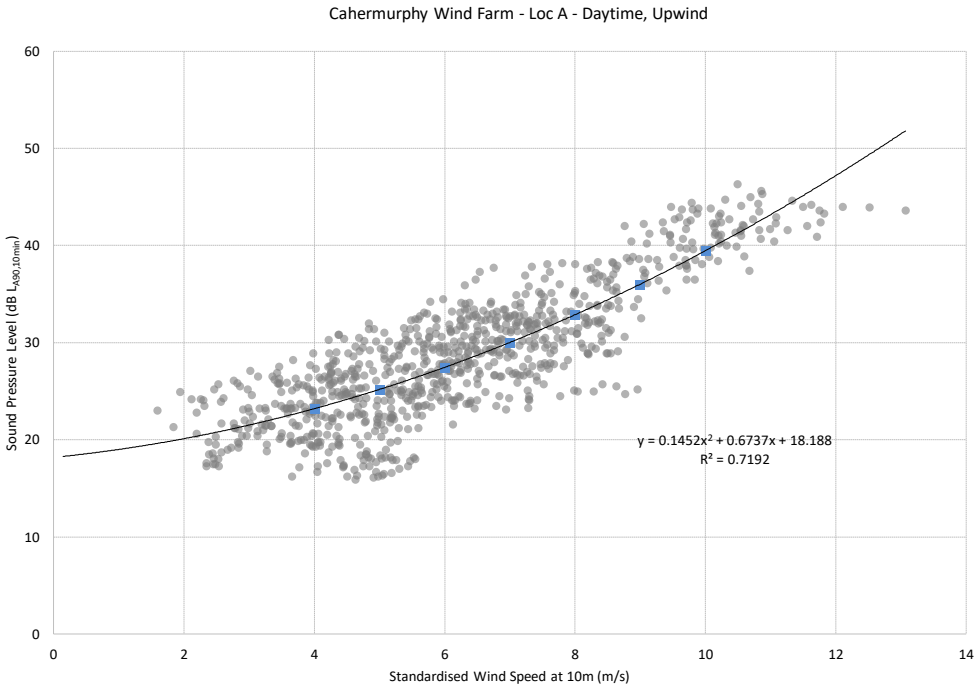


Figure 12-4 Location A (H029) Background Noise Levels $L_{A90,\ 10\,min}$ dB – Daytime

12.5.7.1.2 *Night-time Periods*

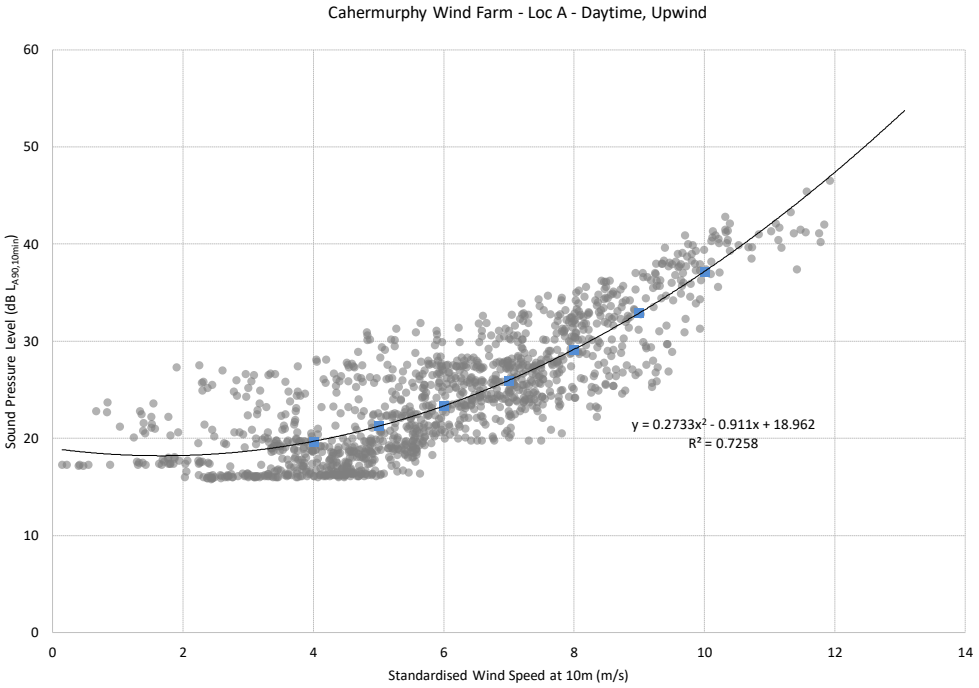


Figure 12-5 Location A (H029) Background Noise Levels $L_{A90,\,10\,min}$ dB –Night -time

12.5.7.2 Location B (H016)

12.5.7.2.1 *Daytime Quiet Periods*

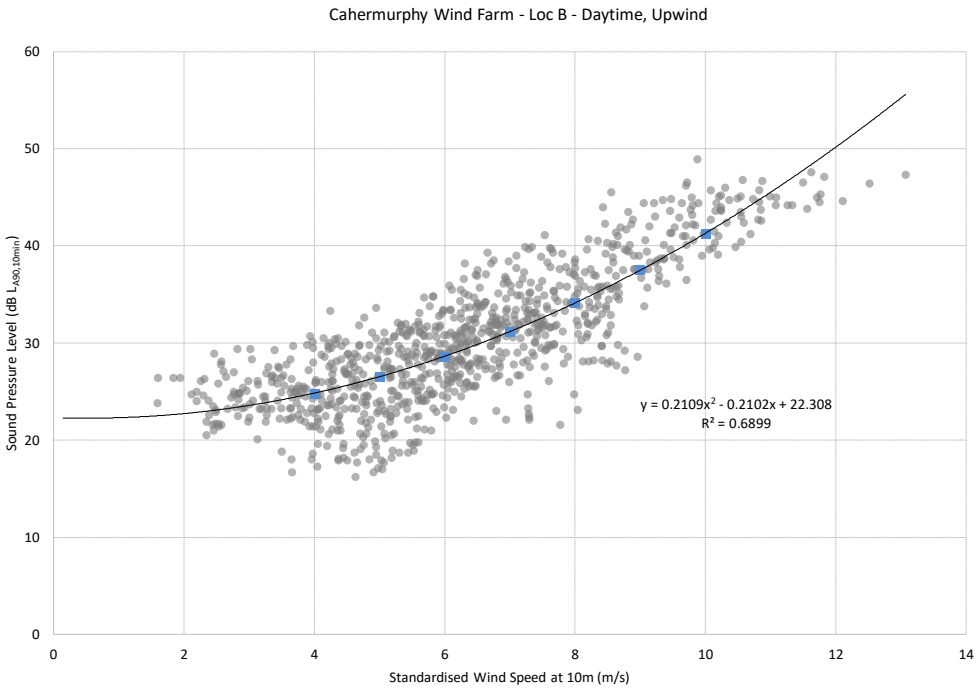


Figure 12-6 Location B (H016) Background Noise Levels $L_{A90,\,10\,min}$ dB – Daytime

12.5.7.2.2 Night-time Periods

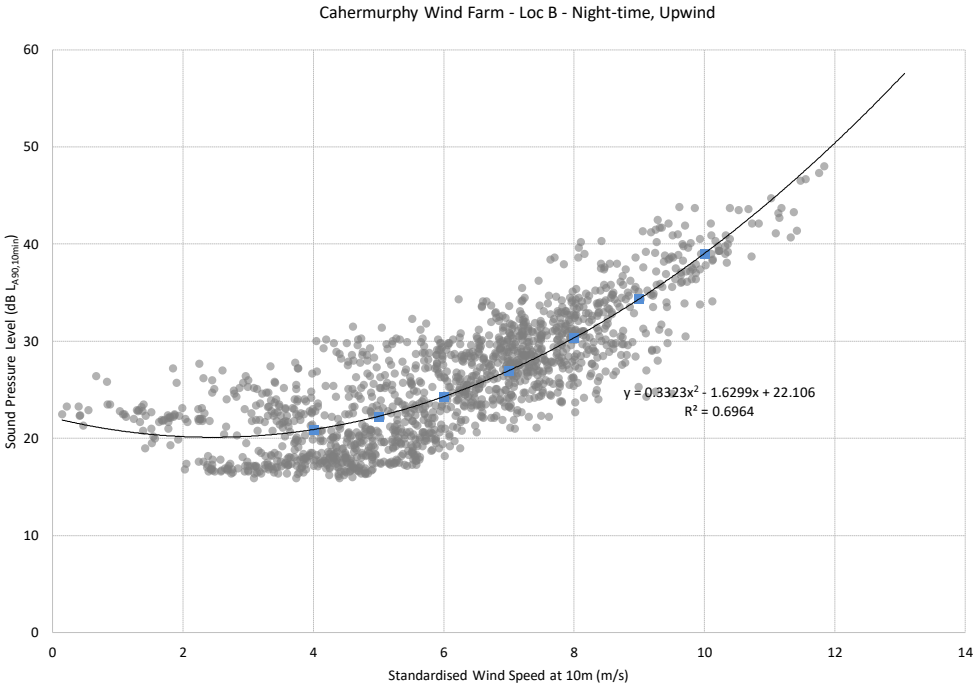


Figure 12-7 Location B (H016) Background Noise Levels $L_{A90,\ 10\ min}$ dB –Night -time

12.5.7.3 Location C (H023)

12.5.7.3.1 Daytime Quiet Periods

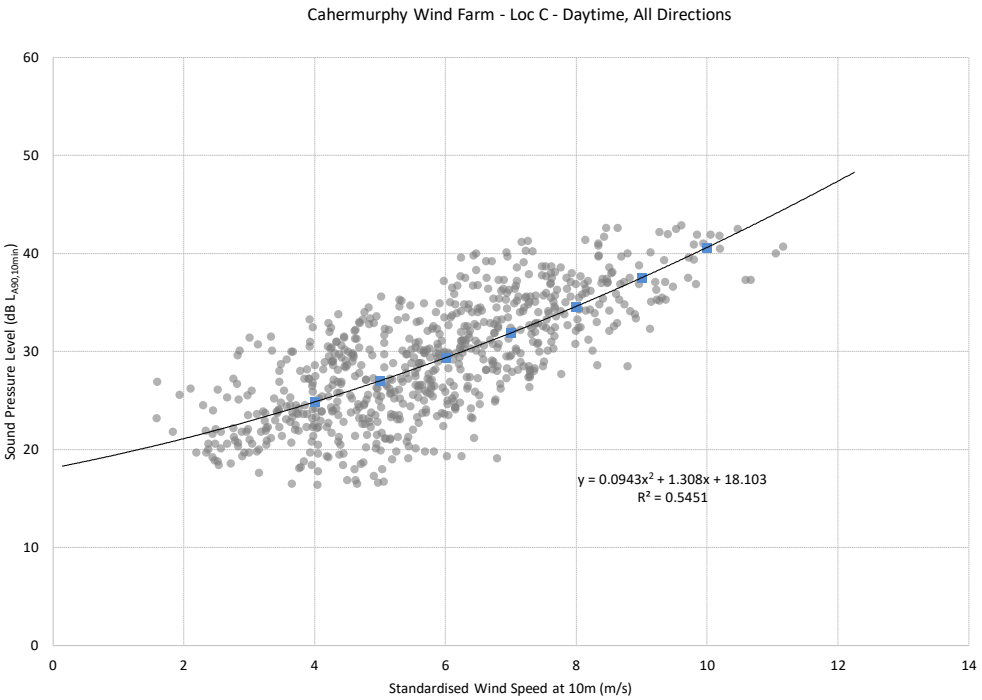


Figure 12-8 Location C (H023) Background Noise Levels $L_{A90,\ 10\ min}$ dB –Daytime

12.5.7.3.2 Night-time Periods

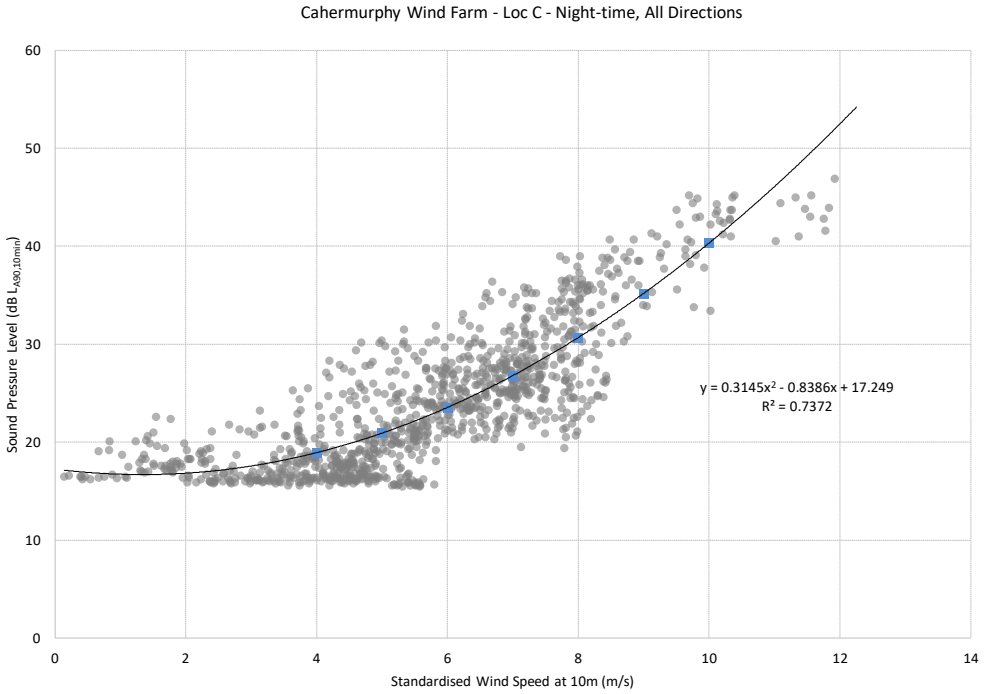


Figure 12-9 Location C (H023) Background Noise Levels $L_{A90,\ 10\ min}$ dB –Night -time

12.5.7.4 Location D (H075)

12.5.7.4.1 Daytime Quiet Periods

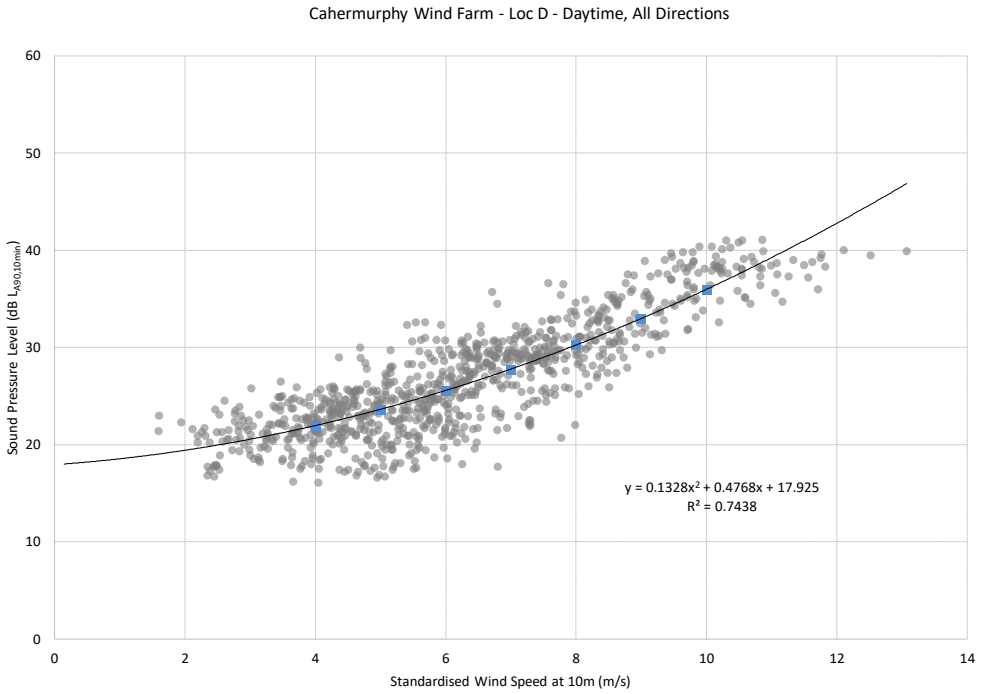


Figure 12-10 Location D (H075) Background Noise Levels $L_{A90,\ 10\ min}$ dB –Daytime

12.5.7.4.2 Night-time Periods

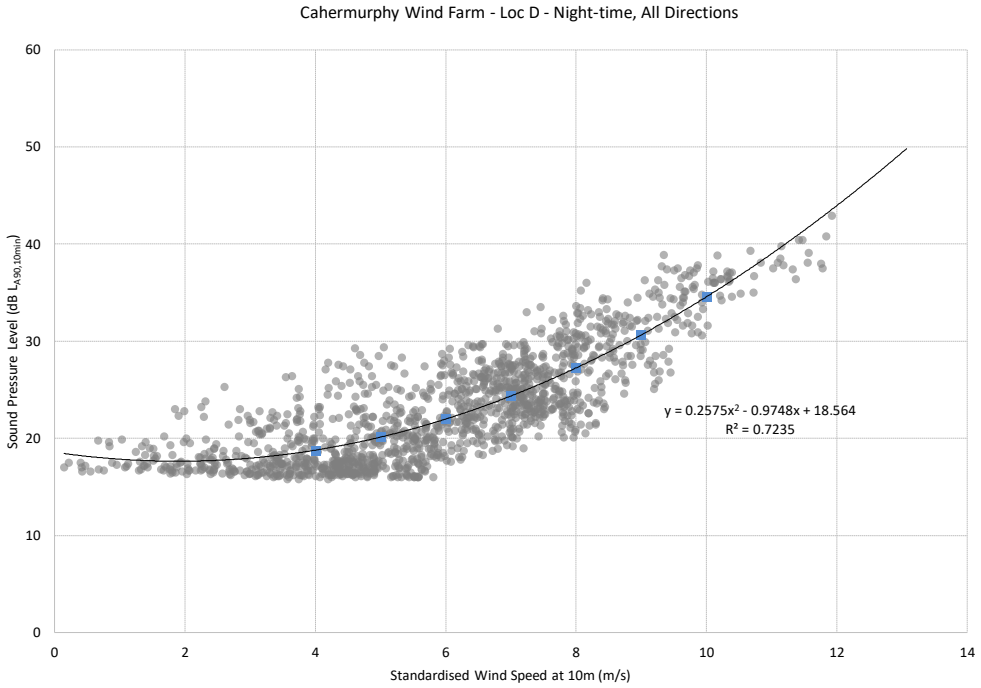


Figure 12-11 Location D (H075) Background Noise Levels $L_{A90,\,10\,min}$ dB – Night -time

12.5.7.5 Location E (H028)

12.5.7.5.1 Daytime Quiet Periods

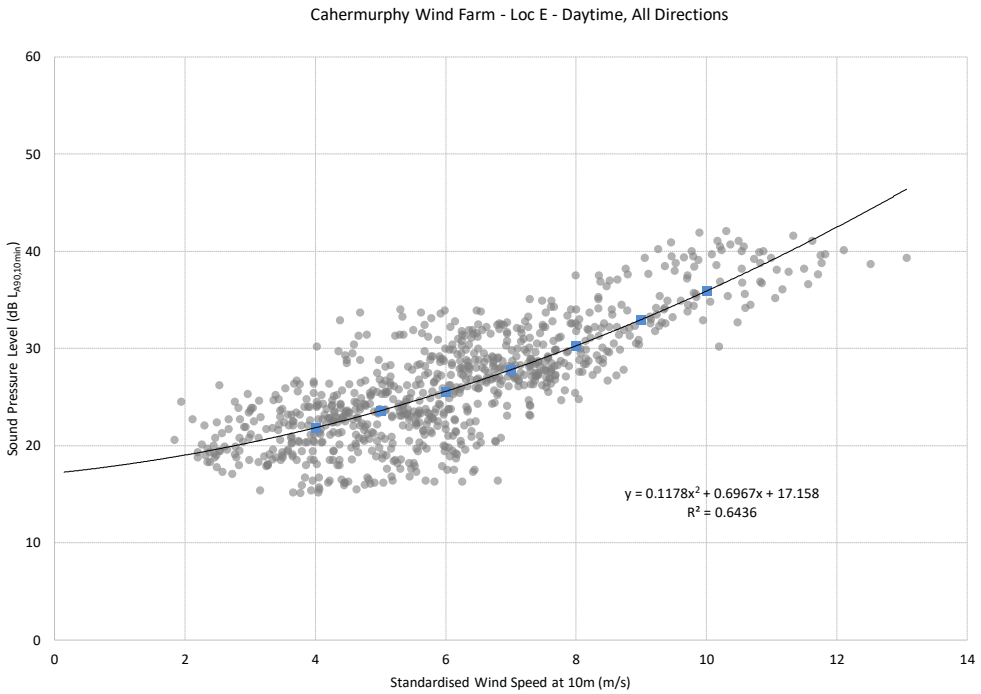


Figure 12-12 Location E (H028) Background Noise Levels $L_{A90,\,10\,min}$ dB – Daytime

12.5.7.5.2 Night-time Periods

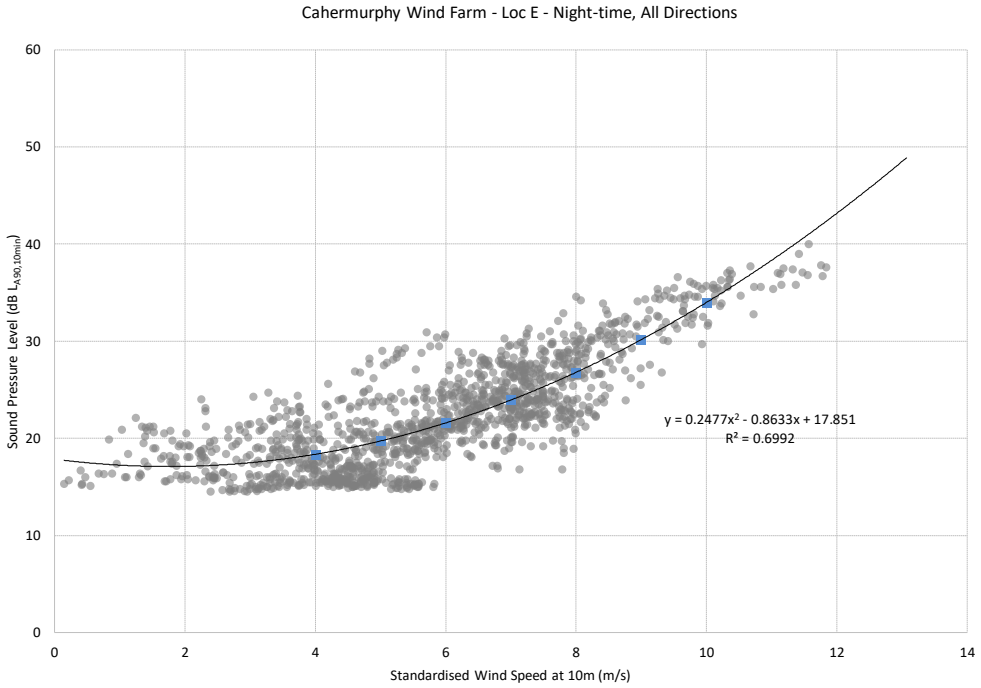


Figure 12-13 Location E (H028) Background Noise Levels $L_{A90,\ 10\ min}$ dB – Night -time

12.5.7.6 Summary

Table 12-11 presents the various derived $L_{A90,10min}$ 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 its SGN No. 2 *Data Collection.*

Table 12-11 Derived Noise Levels of $L_{A90,10min}$ for Various Wind Speeds

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 (H029)	Day	21.5	23.2	25.2	27.5	30.0	32.9	36.0	39.4
	Night	18.8	19.8	21.3	23.3	26.0	29.1	32.9	37.2
B (H016)	Day	23.6	24.8	26.5	28.6	31.2	34.1	37.5	41.3
	Night	20.2	20.9	22.3	24.3	27.0	30.3	34.3	39.0
C (H023)	Day	22.9	24.8	27.0	29.3	31.9	34.6	37.5	40.6
	Night	17.6	18.9	20.9	23.5	26.8	30.7	35.2	40.3
D (H075)	Day	20.6	22.0	23.6	25.6	27.8	30.2	33.0	36.0
	Night	18.0	18.8	20.1	22.0	24.4	27.2	30.6	34.6

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
E (H028)	Day	20.3	21.8	23.6	25.6	27.8	30.3	33.0	35.9
	Night	17.5	18.4	19.7	21.6	23.9	26.8	30.1	34.0
Envelope	Day	20.3	21.8	23.6	25.6	27.8	30.2	33.0	35.9
	Night	17.5	18.4	19.7	21.6	23.9	26.8	30.1	34.0

The background noise data is used to derive appropriate noise limits for each of the noise sensitive locations. In a situation where measurements have been conducted near another receiver, the background noise levels measured nearby have been deemed representative for establishing appropriate noise limits. At all remaining locations, the worst-case envelope based on the lowest average levels across the various locations at each wind speed is used, considered separately for daytime and night-time. The assignment of background noise levels to noise-sensitive locations is presented in Table 12-12.

Table 12-12 Assignment of background noise curves to noise-sensitive locations

Representative Background Noise Levels	Noise Sensitive Location (NSL)
A	H029, H030, H031, H032 and H033
B	H016
C	H023
D	H075
E	H028
Envelope	All other locations

12.6 Likely Significant Effects and Associated Mitigation Measures

12.6.1 Do-Nothing Scenario

If the development were not to proceed then the existing noise environment will remain largely unchanged considering the permitted wind turbine developments and commercial forestry operations in the area.

12.6.2 Construction Phase

A variety of items of plant will be in use for the purposes of site preparation, construction of turbines, hardstanding, roads, substation, met mast, temporary construction compound, internal cables, tree felling, borrow pits and grid connection option. 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.

The predicted noise levels referred to in this section are indicative only and are intended to demonstrate that it will be possible for the contractor to 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.

12.6.2.1 General Construction – Turbines, Hardstanding, Met Mast and Construction Compound

12.6.2.1.1 *Noise*

As the construction programme has been established in outline form only, it is difficult to calculate the actual magnitude of noise emissions to the local environment. However, it is possible to predict typical noise levels 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*.

Turbine foundation works are anticipated at a distance of some 700m from the nearest NSL, H001, at turbine T06. The next nearest NSLs are H075 and H092, which are located approximately 702m to the nearest proposed turbine locations at T01 and T10 respectively.

Several indicative sources that would be expected on a site of this nature have been identified and noise predictions of their potential impacts prepared to nearby houses. The assessment is representative of a worst-case, construction noise levels will be lower at properties located further from the works.

Table 12-13 outlines the noise levels associated with 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 12-13 Typical Construction Noise Emission Levels – Turbines and Hardstanding and Met Mast and Construction Compound

Item (BS 5228 Ref.)	Activity/ Notes	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [8]
HGV Movement (C.2.30)	Removing soil and transporting fill and other materials.	79
Tracked Excavator (C.4.64)	Removing soil and rubble in preparation for foundation.	77
Excavator-mounted Rock Breaker (C9.12)	Excavation in rocky areas	85

[8] *All plant noise levels are derived from BS 5228: Part 1*

Item (BS 5228 Ref.)	Activity/ Notes	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [8]
Piling Operations (C.12.14)	Standard pile driving.	88
General Construction (Various)	All general activities plus deliveries of materials and plant.	84
Dewatering Pumps (D.7.70)	If required.	80
JCB (D.8.13)	For services, drainage and landscaping.	82
Vibrating Rollers (D.8.29)	Road surfacing.	77

Assuming as a worst-case that all turbines and hardstands, met mast and construction compound were to be constructed simultaneously, the noise levels for the houses with the top 5 levels are presented in Table 12-14.

Table 12-14 Worst-case predicted noise levels for turbine and hardstands and met mast construction

NSL Ref	Predicted Noise Level (dB $L_{Aeq,T}$)
H023	45
H028	43
H057	43
H026	43
H088	43

The values are well below the construction noise criteria in Table 12-5 for daytime and for evening time. It is concluded that there are no significant noise impacts associated with the construction of the turbine hardstands, construction compound and met mast and therefore no specific mitigation measures are required, over and above the best practice measures described in Section 12.6.2.8.

12.6.2.1.2 Vibration

Due to the distance of the proposed works from sensitive locations significant vibration effects are not expected.

12.6.2.2 Construction of Internal Roads (including Tree Felling and laying of underground cables)

It is proposed to upgrade existing internal roads and also to construct new internal roads, lay underground cables and to fell trees as part of the development. Review of the road layout has identified that the nearest NSL to any point along the proposed roads is approximately 200m to location H029 (509696E, 668726N). The nearest NSL to tree felling is H029 509696E, 668726N.All other locations are at greater distances with the majority at significantly greater distances. The full description of the new roads is outlined in Chapter 4 of the EIAR.

12.6.2.2.1 *Noise*

Table 12-15 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.

Table 12-15 Typical Construction Noise Emission Levels – Internal Roads, tree felling and laying of underground cables

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [9]	Highest Predicted Noise Level at 200m from Edge of Works(dB LAeq,T)
Petrol-driven chainsaw	86	54
HGV Movement (C.2.30)	79	47
Excavator Mounted Rock Breaker (C9.12)	85	53
Vibrating Rollers (D.8.29)	77	45
Total Construction Noise (cumulative for all activities)		**57**

At the nearest noise sensitive location, the predicted noise levels from construction activities are of the order of 57 dB $L_{Aeq,T}$, below the significance threshold of 65dB $L_{Aeq,1hr}$. Given the variations of on-site activities, the number of plant items operating at any one time and the location of upgrading road works only operating along the closest boundaries for a limited duration of the overall development, the calculated noise levels presented are considered to present a worst-case scenario. As these works will progress along the route the worst-case predicted impacts will reduce. It is envisioned that they would be at the closest position to the nearest NSL for no more than 2 to 3 days. The resulting noise impact is not significant.

12.6.2.2.2 *Vibration*

Due to the distance of the proposed works from sensitive locations significant vibration effects are not expected.

[9] *All plant noise levels are derived from BS 5228: Part 1*

12.6.2.3 Borrow Pits

12.6.2.3.1 *Noise*

To inform this aspect of the proposal a comparative noise assessment has been prepared and is outlined in the following paragraphs. Two situations have been considered as follows:

- Scenario A Blasting operation[10]
- Scenario B Rock breaking operation

In terms of these activities please note the following:

- A mobile crusher will operate on site for both options.
- In Scenario B that two rock breakers will be in use on site during daytime periods for an estimated three-month period.
- For the purposes of this assessment we have assumed the plant is working in the vicinity of the potential borrow pits location indicated Table 12-16.
- Table 12-17 outlines the assumed noise levels for the plant items as extracted from BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise*.

Table 12-16 Proposed Borrow Pit Locations

Borrow Pit ID	Co-ordinates	
	Easting	Northing
BOR 1	508564	669588
BOR 2	509253	668690

Table 12-17 Typical Plant Noise Levels

Item	BS 5228 Ref:	dB Lw Levels per Octave Band (Hz)								dB(A)
		63	125	250	500	1k	2k	4k	8k	
Crusher	Table C1.14	121	114	107	109	103	99	94	87	110
Rock Breaker	Table C9.11	119	117	113	117	115	115	112	108	121

A construction noise model has been prepared to consider the expected noise emissions from the proposed construction works for the two scenarios outlined above. A percentage on-time of 66% has been assumed for the noise calculations. The predicted levels are detailed in Table 12-18 at the 10 no. closest NSL's to the borrow pits acting together.

[10] *Note that blasting may be required at some turbine base locations. If this is the case the mitigation measures detailed in the relevant section of this chapter will be applicable to these activities. The assessment presented here for borrow pit activities will be comparable to those expected in relation to works associated with turbine foundations.*

Table 12-18 Typical Plant Noise Levels Borrow Pits

Borrow Pit 1 and Borrow Pit 2			
Loc.	Predicted Construction Noise Level LAeq,1hr Scenario		Diff. dB(A)
	A	B	
H029	40	51	-11
H030	39	49	-10
H031	38	48	-10
H032	37	48	-11
H033	37	47	-10
H034	36	46	-10
H092	36	45	-9
H035	35	44	-9
H003	33	42	-9
H012	33	42	-9

Review of the data contained in Table 12-18 confirms the following:

- Predicted construction noise levels for both Scenario A and B at all borrow pits are well within the best practice construction noise criteria outlined in Table 12-5. It is assumed that construction works at the borrow pits will only occur during daytime periods only (07:00 to 19:00hrs).
- The blasting proposal results in lower levels of construction noise since the use of the rock breaking plant is not required in this instance. Predicted noise levels are lower at all assessed locations for Scenario A.
- It is accepted that the individual blast events will be audible at some locations. Blast events will be designed and controlled such that the best practice noise and vibration limit values outlined in the mitigation section of this chapter are not exceeded.

12.6.2.3.2 Vibration

Due to the distance of the proposed works from sensitive locations significant vibration effects are not expected.

12.6.2.4 Substation

12.6.2.4.1 *Noise*

The substation is to be constructed at one of two possible locations: either Option A in Carrownagry South townland or Option B in Cahermurphy townland, as shown in Figure 4.11 and Figure 4.12 in Chapter 4 of the EIAR. The noise impact at the nearest NSL has been assessed to identify the potential greatest impact associated with each option.

The nearest NSL to the Option A substation site is at approximately H001 at approximately 440m to the northeast. The nearest NSL to the Option B substation is H029 at approximately 250m to the southeast. Taking Option B as a worst-case example and assuming the same construction activities as outlined in Section 12.6.2.1, it is predicted that the likely worst-case potential noise levels from construction activities associated with the substation will be in the order of 57 dB $L_{Aeq,T}$ at Location H029. This level of noise is significantly below the daytime construction noise criterion outlined in Table 12-5.

12.6.2.4.2 *Vibration*

Due to the distance of the proposed works from sensitive locations significant vibration effects are not expected.

12.6.2.5 Grid Connection Construction

12.6.2.5.1 *Noise*

The onsite substation will connect to the existing Booltiagh 110kV substation located approximately 7 kilometres to the southeast of the site. Connection via the Booltiagh route will comprise underground cabling, measuring approximately 12.1 km in total, located on existing forestry and agricultural land and within the public road corridor. The full description of the proposed grid connection arrangements for the proposed development is outlined in Chapter 4 of the EIAR.

Construction activities will be carried out during normal daytime working hours (i.e. weekdays 0700 – 1900hrs and Saturdays 0700 – 1300hrs).

Table 12-19 outlines the noise levels associated with typical construction noise sources assessed with the proposed works for the grid connection at varying distances from the cable route.

Table 12-19 Indicative Noise Levels from Construction Plant at Nearest NSL from the Grid Connection Works

Item (BS 5228 Ref.)	Highest Predicted Plant Noise Level [11] (dB $L_{Aeq,T}$)				
	15m Distance	20m Distance	30m Distance	45m Distance	60m Distance
Mini Excavator with Hydraulic Breaker (C5.2)	75	72	67	63	61
Wheeled loader (C2.28)	68	65	60	56	54

[11] *All plant noise levels are derived from BS 5228: Part 1*

Item (BS 5228 Ref.)	Highest Predicted Plant Noise Level [11] (dB $L_{Aeq,T}$)				
	15m Distance	20m Distance	30m Distance	45m Distance	60m Distance
Tracked excavator (C2.8)	62	59	54	50	48
Dozer (C2.13)	70	67	62	58	56
Dump truck (C2.30)	71	68	63	59	57
Road Roller (C2.30)	67	64	59	55	53
HGV Movements (20 per hour)	51	48	43	39	37
Total Construction Noise	**78**	**75**	**71**	**66**	**64**

At distances between 15 and 45m, the predicted cumulative noise levels from construction activities are of the range of 66-78dB $L_{Aeq,T}$, which are above the significance threshold of 65dB $L_{Aeq,1hr}$. Given the variations of grid connection activities, the number of plant items operating at any one time and the location of upgrading road works only operating along the closest boundaries for a limited duration of the overall development, the calculated noise levels presented are considered to present a worst-case scenario. As these works will progress along the route the worst-case predicted impacts will reduce. At locations at 65m or further from the works, the predicted noise levels are in the order of 64dB $L_{Aeq,T}$. which is below the significance threshold of 65dB $L_{Aeq,1hr}$.

Where a noise sensitive location is within 45m of works detailed consideration to potential construction noise impacts will be required and appropriate mitigation measures implemented in order to manage associated impacts. Typical mitigation measures that can be considered are outlined in the mitigation section of this document with further guidance contained within the BS 5228 standards. It should be noted that these works will progress along the route and it is envisioned that would be carried out and completed in the vicinity of any property in 2 to 3 days.

12.6.2.5.2 *Vibration*

Due to the distance of the proposed works from sensitive locations significant vibration effects are not expected.

12.6.2.6 Construction Traffic

12.6.2.6.1 *Noise*

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 15 Material Assets has been used to inform the assessment here. The following situations are commented upon here:

- Stage 1a – Site Preparation – Concrete Pouring
- Stage 1b – Site Preparation & Ground Works

- Stage 2a – Turbine Construction Stage – Extended Artic Deliveries
- Stage 2b – Turbine Construction Stage – Other Conventional Deliveries

Please note stage 1 includes for the preparation, groundworks and construction of the turbine foundations, internal cabling and grid connection, access roads, met mast foundations, substation foundations/construction, construction compound and tree felling.

Stage 2 includes for turbine delivery and all other conventional deliveries associated with construction of all other elements of the project such as met mast and sub-station.

Table 12-20 Assumptions for Construction Traffic Noise Assessment

Route	Stage	Traffic Units	%HGV
1 N68 – Ballyduneen	Existing	7,043	8%
	1a	7,473	12%
	1b	7,136	8%
	2a	7,148	9%
	2b	7,103	8%
2 R484 – Ballyduneen	Existing	2,038	8%
	1a	2,468	21%
	1b	2,131	9%
	2a	2,143	10%
	2b	2,098	8%
3 Creegh Road – Creegh North	Existing	350	15%
	1a	350	15%
	1b	350	15%
	2a	410	28%
	2b	350	15%
4 Casltepark Road	Existing	230	15%
	1a	660	60%
	1b	323	18%
	2a	275	13%
	2b	290	17%

Based on the assumptions presented above changes in noise level based on the existing flows have been estimated and is presented in Table 12-20.

Table 12-21 Estimated Changes in Traffic Noise Levels

Route	Stage	Change in Traffic Noise Level dB(A)	Estimated Number of Days
1 N68 – Ballyduneen	1a	0.3	10
	1b	0.1	245
	2a	0.1	30
	2b	0.0	10
2 R484 - Ballyduneen	1a	0.8	10
	1b	0.2	245
	2a	0.2	30
	2b	0.1	10
3 Creegh Road – Creegh North	1a	0.0	10
	1b	0.0	245
	2a	0.7	30
	2b	0.0	10
4 Castlepark Road	1a	4.6	10
	1b	1.5	245
	2a	0.8	30
	2b	1.0	10

The increase in noise levels due to additional construction traffic on each of the routes is predicted to be less than 1.1 dB or less for most Stages along most of the routes. With respect to the assessment criteria outlined in Section 12.4.1.2 the magnitude of this impact is negligible. During Stage 1a, the predicted increase in noise levels is of the order of 4.6 dB (along Castlepark Road). With respect to the appropriate assessment criteria, the magnitude of this impact is moderate.

12.6.2.6.2 *Vibration*

No significant vibration impacts are expected from due to construction traffic.

12.6.2.7 Construction Phase General Mitigation Measures

Regarding construction activities, reference will be made to BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise*, which offers detailed guidance

on the control of noise & vibration from demolition and construction activities. It is proposed that various practices be adopted during construction, including:

- Managing the hours according to the CEMP [Appendix 4-4] 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.

12.6.2.8 Construction Phase Mitigation Measures – Noise

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 considered, where necessary, 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 Table 12-5 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 could occasionally be necessary to work out of these hours.

Where rock breaking is employed in relation to the proposed borrow pit location, the following are examples of measures that will be employed, where necessary, to mitigate noise emissions from these activities:

- Fit suitably designed muffler or sound reduction equipment to the rock breaking tool to reduce noise without impairing machine efficiency.
- Ensure all leaks in air lines are sealed.
- Use a dampened bit to eliminate ringing.
- Erect acoustic screen between compressor or generator and noise sensitive area. When possible, line of sight between top of machine and reception point needs to be obscured.
- Enclose breaker or rock drill in portable or fixed acoustic enclosure with suitable ventilation.

Air overpressure from a blast is difficult to control, however, because of its variability much can be done to reduce the effect. A reduction in the amount of primer cord used, together with the adequate burial of any that is above the ground, can give dramatic reduction to air overpressure intensities especially in the audible frequency range. Most complaints are likely to be received from an area downwind of the blast site, and therefore, if air blast complaints are a continual problem, it would be advisable to postpone blasting during unfavourable weather conditions if possible. As air blast intensity is a function of total charge weight, then a reduction in the total amount of explosives used can also reduce the air overpressure value.

Further guidance will be obtained from the recommendations contained within BS 5228: Part 1 and the European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations 1988 in relation to blasting operations.

The methods used to minimise impacts will consist of the following:

- Restriction of hours within which blasting can be conducted (e.g. 09:00 – 18:00hrs).
- Notification to nearby residents before blasting starts (e.g. 24-hour written notification).
- The firing of blasts at similar times to reduce the ‘startle’ effect.
- On-going circulars informing people of the progress of the works.
- The implementation of an onsite documented complaints procedure.
- The use of independent monitoring by external bodies for verification of results.
- Trial blasts in less sensitive areas to assist in blast designs and identify potential zones of influence.

12.6.2.9 Construction Phase Mitigation Measures – Vibration

It is recommended that vibration from construction activities be limited to the values set out in Table 12-7. 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%.

Considering the large distances between locations where piling may take place and the nearest noise sensitive locations, no significant impact will be experienced. Therefore, no mitigation measures are proposed for piling operations.

Specific to blasting the following mitigation measures will be employed to control the impact during blasts:

- Trial blasts may be undertaken to obtain scaled distance analysis;
- Ensuring appropriate burden to avoid over or under confinement of the charge;
- Accurate setting out and drilling;
- Appropriate charging;
- Appropriate stemming with appropriate material such as sized gravel or stone chipping;
- Delay detonation to ensure small maximum instantaneous charges;
- Decked charges and in-hole delays;
- Blast monitoring to enable adjustment of subsequent charges;
- Good blast design to maximise efficiency and reduce vibration;
- Avoid using exposed detonating cord on the surface.

12.6.3 Operational Phase

12.6.3.1 Wind Turbine Noise Criteria Curves

With respect to the relevant guidance documents outlined in Section 12.4.2.1 the following noise criteria curves have been identified for the proposed development. The criteria curves have been derived following a detailed review of the background noise data conducted at the nearest noise sensitive locations.

It is proposed to adopt a lower daytime threshold of 40 dB $L_{A90,10min}$ 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 considered appropriate in light of the following:

- The EPA document 'Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)' 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.
- 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 a review of other national guidance in relation to acceptable noise levels in areas of low background noise 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 LA90,10min 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.

Table 12-22 outlines the derived noise criteria curves based on the information contained within Table 12-11 and the assignments of background noise levels to noise-sensitive locations as presented in Table 12-12.

Table 12-22 Noise Criteria Curves

Location	Period	Noise Criteria $L_{A90,\ 10\ min}$ (dB) at various Standaridsed 10m Height Wind Speeds (m/s)							
		3	4	5	6	7	8	9	10
H029, H030, H031, H032, H033	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
H016	Day	40.0	40.0	40.0	40.0	45.0	45.0	45.0	46.3
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0
H023	Day	40.0	40.0	40.0	40.0	45.0	45.0	45.0	45.6
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3
H075	Day	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
H028	Day	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
All other locations	Day	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0

12.6.3.2 Turbine Noise Assessment

The noise levels for the proposed site have been calculated for all noise sensitive receivers identified within 1.2 km of the proposed turbines.

A worst-case assessment has been completed assuming all noise locations are downwind of all turbines at the same time. The predicted noise levels include Cahermurphy 1 and Kiltumper wind farms. The predicted levels have been compared against the adopted noise criteria curves as detailed in Table 12-22. Table 12-23 presents the details of the exercise at all 100 no. noise sensitive locations considered as part of this assessment.

Table 12-23 Review of Cumulative Predicted Turbine Noise Levels against Relevant Criteria

House ID	Description	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	≥9
H01	Dwelling	34.7	38.4	41.8	42.8	43.1	43.4
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	1.8	2.8	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	0.1	0.4
H02	Dwelling	33.6	37.6	41	42	42.3	42.4
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	1	2	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–

House ID	Description	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	≥9
H03	Dwelling	33.5	37.6	41	42	42.2	42.4
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	1	2	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H04	Dwelling	33.2	37.5	41	42	42.2	42.2
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	1	2	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H05	Dwelling	32.7	37	40.5	41.5	41.7	41.7
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	0.5	1.5	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H06	Dwelling	32.2	36.4	39.8	40.9	41	41.2
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.9	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H07	Dwelling	32.3	36.6	40.1	41.1	41.3	41.3
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	0.1	1.1	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H08	Dwelling	27.1	31.3	34.9	35.9	36	36.1
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H09	Dwelling	28.6	33	36.6	37.6	37.6	37.6
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H010	Dwelling	30.2	34.6	38.3	39.2	39.3	39.3
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–

House ID	Description	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	≥9
H011	Dwelling	28.9	33.3	36.9	37.9	38	38
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H012	Dwelling	29.7	33.8	37.4	38.5	38.7	38.9
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H013	Dwelling	29	33.1	36.7	37.8	38.1	38.3
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H014	Dwelling	29.3	33.5	37.1	38.1	38.4	38.6
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H015	Dwelling	29.9	34.1	37.7	38.8	39	39.1
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H016	Dwelling	28.8	33.1	36.7	37.7	37.9	38
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H017	Dwelling	27.1	31.3	35	36	36.3	36.4
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H018	Dwelling	28.2	32.5	36.1	37.1	37.3	37.4
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–

House ID	Description	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	≥9
H019	Dwelling	27.6	31.9	35.6	36.7	36.9	37
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H020	Dwelling	26.4	30.6	34.3	35.4	35.7	35.9
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H021	Dwelling	26.6	30.8	34.4	35.5	35.8	36
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H022	Dwelling	32.2	36.7	40.3	41.3	41.4	41.4
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	0.3	1.3	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H023	Dwelling	33.7	38.3	42	42.9	43	43
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	2	2.9	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H024	Dwelling	31.9	36.4	40	41	41	41
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	1	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H025	Dwelling	32.6	37.1	40.7	41.7	41.8	41.8
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	0.7	1.7	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H026	Dwelling	32.9	37.4	41.1	42.1	42.1	42.1
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	1.1	2.1	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–

House ID	Description	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	≥9
H027	Dwelling	32	36.5	40.1	41.1	41.2	41.2
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	0.1	1.1	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H028	Dwelling	33	37.5	41.2	42.1	42.2	42.2
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	1.2	2.1	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H029	Dwelling	34.7	38.5	41.9	43	43.3	43.5
	Daytime Criterion	40	40	40	45	45	45
	Daytime Excess	–	–	1.9	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	0.3	0.5
H030	Dwelling	34.3	38	41.4	42.4	42.8	43
	Daytime Criterion	40	40	40	45	45	45
	Daytime Excess	–	–	1.4	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H031	Dwelling	34.5	38.2	41.4	42.5	42.9	43.2
	Daytime Criterion	40	40	40	45	45	45
	Daytime Excess	–	–	1.4	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	0.2
H032	Dwelling	35.1	38.6	41.7	42.9	43.3	43.7
	Daytime Criterion	40	40	40	45	45	45
	Daytime Excess	–	–	1.7	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	0.3	0.7
H033	Dwelling	34.3	37.8	41	42.2	42.6	43
	Daytime Criterion	40	40	40	45	45	45
	Daytime Excess	–	–	1	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H034	Dwelling	34.6	38	41.1	42.3	42.7	43.2
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	1.1	2.3	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	0.2

House ID	Description	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	≥9
H035	Dwelling	34.3	37.5	40.6	41.8	42.3	42.7
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	0.6	1.8	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H036	Dwelling	27.2	31.3	34.9	36	36.3	36.5
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H037	Dwelling	31	35.5	39.1	40.1	40.2	40.2
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.1	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H038	Dwelling	30.8	35.3	39	40	40.1	40
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H039	Dwelling	31.3	35.8	39.4	40.4	40.5	40.5
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.4	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H040	Dwelling	30.5	35	38.6	39.6	39.7	39.7
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H041	Dwelling	25.9	30.4	34.1	35.1	35.2	35.2
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H042	Dwelling	25.3	29.7	33.4	34.5	34.6	34.7
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–

House ID	Description	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	≥9
H043	Dwelling	30.9	35.4	39	40	40.1	40.1
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H044	Dwelling	30.8	35.3	39	40	40	40
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H045	Dwelling	30.5	35	38.7	39.7	39.7	39.7
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H046	Dwelling	30.4	34.9	38.6	39.5	39.6	39.6
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H047	Dwelling	26.7	31.2	34.9	35.9	36	36
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H048	Dwelling	27.9	32.4	36.1	37.1	37.1	37.1
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H049	Dwelling	28.4	32.9	36.6	37.6	37.6	37.6
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H050	Dwelling	28.9	33.4	37	38	38.1	38
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–

House ID	Description	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	≥9
H051	Dwelling	29.1	33.6	37.2	38.2	38.3	38.3
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H052	Dwelling	29.5	34	37.6	38.6	38.7	38.6
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H053	Dwelling	28.8	33.4	37	38	38	38
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H054	Dwelling	28.7	33.2	36.9	37.9	37.9	37.9
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H055	Dwelling	29.5	34	37.7	38.7	38.7	38.7
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H056	Dwelling	30	34.6	38.2	39.2	39.2	39.2
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H057	Dwelling	33	37.5	41.2	42.2	42.2	42.2
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	1.2	2.2	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H058	Dwelling	31.2	35.7	39.4	40.4	40.4	40.4
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.4	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–

House ID	Description	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	≥9
H059	Dwelling	31	35.6	39.2	40.2	40.3	40.2
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.2	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H060	Dwelling	31.3	35.9	39.5	40.5	40.5	40.5
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.5	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H061	Dwelling	31.3	35.8	39.5	40.5	40.5	40.5
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.5	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H062	Dwelling	31.4	36	39.6	40.6	40.6	40.6
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.6	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H063	Dwelling	31.2	35.7	39.4	40.4	40.4	40.4
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.4	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H064	Dwelling	30.9	35.5	39.1	40.1	40.2	40.1
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.1	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H065	Dwelling	26.2	30.7	34.4	35.4	35.4	35.4
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H066	Dwelling	26.1	30.6	34.2	35.2	35.3	35.2
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–

House ID	Description	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	≥9
H067	Dwelling	26.4	30.9	34.6	35.6	35.6	35.6
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H068	Dwelling	26.3	30.8	34.4	35.4	35.4	35.4
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H069	Dwelling	26.7	31.2	34.9	35.9	35.9	35.9
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H070	Dwelling	28.1	32.6	36.3	37.3	37.3	37.3
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H071	Dwelling	26.6	31.1	34.8	35.8	35.8	35.8
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H072	Dwelling	27.7	32.2	35.8	36.8	36.9	36.8
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H073	Dwelling	27.9	32.4	36.1	37.1	37.1	37.1
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H074	Dwelling	28.2	32.7	36.4	37.4	37.4	37.4
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–

House ID	Description	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	≥9
H075	Dwelling	31.4	35.9	39.6	40.6	40.6	40.6
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.6	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H076	Dwelling	31.2	35.8	39.4	40.4	40.5	40.4
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.4	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H077	Dwelling	31	35.6	39.2	40.2	40.3	40.2
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.2	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H078	Dwelling	29.2	33.7	37.4	38.4	38.4	38.4
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H079	Dwelling	28.8	33.3	37	37.9	38	37.9
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H080	Dwelling	28.6	33.1	36.7	37.7	37.8	37.7
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H081	Dwelling	28.4	32.9	36.6	37.5	37.6	37.5
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H082	Dwelling	28.2	32.7	36.3	37.3	37.4	37.3
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–

House ID	Description	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	≥9
H083	Dwelling	27.1	31.6	35.2	36.2	36.2	36.2
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H084	Dwelling	30.8	35.3	39	40	40	40
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H085	Dwelling	29.8	34.2	37.8	38.8	38.9	38.9
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H086	Dwelling	30.1	34.7	38.3	39.3	39.3	39.3
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H087	Dwelling	31.1	35.6	39.3	40.2	40.3	40.3
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.2	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H088	Dwelling	32.8	37.3	40.9	41.9	41.9	41.9
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	0.9	1.9	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H089	Dwelling	32.7	36.7	40.1	41.2	41.4	41.5
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	0.1	1.2	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H090	Dwelling	32.8	37	40.5	41.5	41.6	41.8
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	0.5	1.5	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–

House ID	Description	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	≥9
H091	Dwelling	31.1	35.6	39.3	40.3	40.3	40.3
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.3	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H092	Dwelling	32.1	36.5	40.1	41.1	41.2	41.2
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	0.1	1.1	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H093	Dwelling	27.3	31.5	35	36	36.1	36.2
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H094	Dwelling	26.4	30.9	34.5	35.5	35.6	35.6
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H095	Dwelling	26.9	31.4	35.1	36.1	36.1	36.1
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H096	Dwelling	27.4	31.9	35.5	36.5	36.6	36.6
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H097	Dwelling	27.5	32	35.6	36.6	36.7	36.7
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H098	Dwelling	27.7	32.2	35.8	36.8	36.9	36.8
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–

House ID	Description	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	≥9
H099	Dwelling	26	30.5	34.2	35.2	35.2	35.2
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–
H100	Dwelling	25.9	30.4	34.1	35.1	35.2	35.3
	Daytime Criterion	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	–	–
	Night time Criterion	43	43	43	43	43	43
	Night time Excess	–	–	–	–	–	–

A noise contour for standard mode operation rated power wind speed (i.e. highest noise emission) has been presented in Appendix 12.4.

The cumulative predicted noise levels at various wind speeds have been compared against the noise criteria curves outlined in Table 12-22. The predicted omni-directional noise levels for all turbines operating in standard mode has identified some exceedances at noise sensitive locations at certain windspeeds.

When considering noise impacts of wind turbines, the effects of propagation in different wind directions can be considered. As previously stated the day to day operations of the proposed 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 12-14 illustrates the directivity attenuation factor that has been applied to turbines when considering noise propagation in downwind conditions.

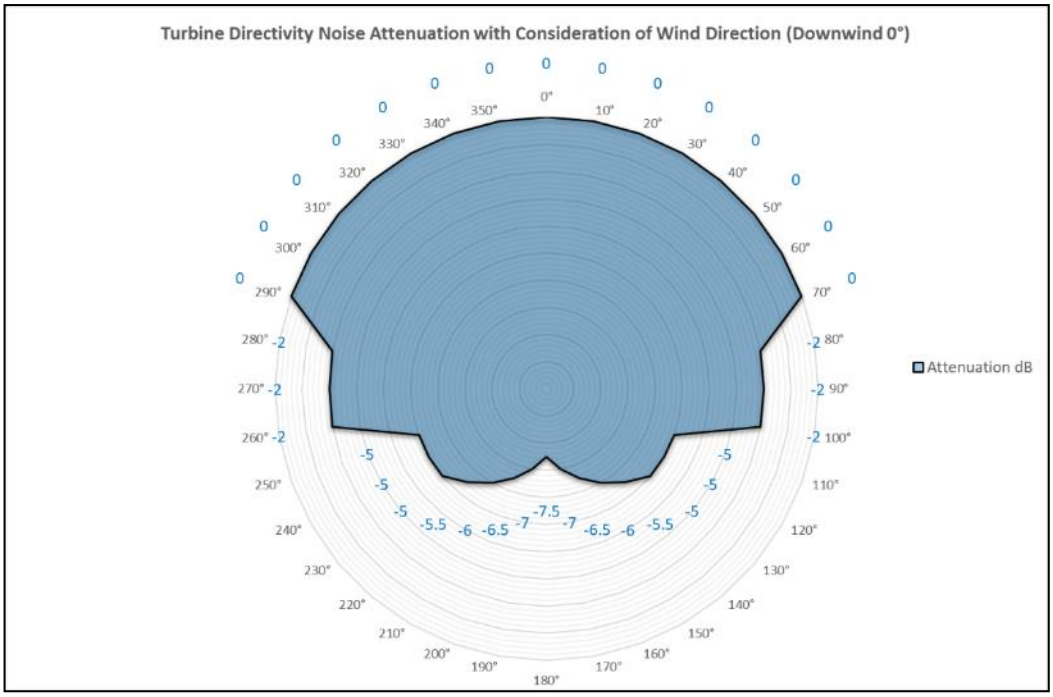


Figure 12-14 Turbine Directivity Attenuation with Consideration of Wind Direction

Directional noise predictions models have been developed to identify the number and magnitude of exceedances to the noise criteria at the various noise sensitive locations with the proposed turbines operating in standard mode. The full tabulated results of this assessment are shown in Appendix 12-5. The list of NSL's with predicted exceedances assuming all turbines operating in standard operating mode are presented Table 12-24 to Table 12-31 for each of the various wind direction sectors that have been assessed.

Table 12-24 Summary of Exceedances Standard Operating Mode in North Wind Direction (0°)

Location	Period	Noise Exceedances (dB L_{A90}, 10min), at various Standaridsed10m Height Wind Speed (m/s)					
		4	5	6	7	8	9
H022	Day	–	–	0.3	1.3	–	–
	Night	–	–	–	–	–	–
H029	Day	–	–	1	–	–	–
	Night	–	–	–	–	–	–
H030	Day	–	–	0.6	–	–	–
	Night	–	–	–	–	–	–
H031	Day	–	–	0.5	–	–	–
	Night	–	–	–	–	–	–
H032	Day	–	–	0.8	–	–	–
	Night	–	–	–	–	–	–
H033	Day	–	–	0.1	–	–	–
	Night	–	–	–	–	–	–
H034	Day	–	–	0.3	1.5	–	–
	Night	–	–	–	–	–	–
H035	Day	–	–	–	1.2	–	–
	Night	–	–	–	–	–	–
H037	Day	–	–	–	0.1	–	–
	Night	–	–	–	–	–	–
H039	Day	–	–	–	0.4	–	–
	Night	–	–	–	–	–	–
	Day	–	–	0.7	1.7	–	–

Location	Period	Noise Exceedances (dB $L_{A90,}$ 10min), at various Standaridsed10m Height Wind Speed (m/s)					
		4	5	6	7	8	9
H057	Night	–	–	–	–	–	–
H091	Day	–	–	–	0.3	–	–
	Night	–	–	–	–	–	–
H092	Day	–	–	–	0.9	–	–
	Night	–	–	–	–	–	–

Table 12-25 Summary of Exceedances Standard Operating Mode in Northeast Wind Direction (45°)

Location	Period	Noise Exceedances (dB LA90, 10min), at various Standaridsed10m Height Wind Speed (m/s)					
		4	5	6	7	8	9
H022	Day	–	–	–	0.4	–	–
	Night	–	–	–	–	–	–
H034	Day	–	–	–	0.7	–	–
	Night	–	–	–	–	–	–
H035	Day	–	–	–	0.4	–	–
	Night	–	–	–	–	–	–
H037	Day	–	–	–	0.1	–	–
	Night	–	–	–	–	–	–
H039	Day	–	–	–	0.3	–	–
	Night	–	–	–	–	–	–
H057	Day	–	–	1.2	2.2	–	–
	Night	–	–	–	–	–	–
H058	Day	–	–	–	0.4	–	–
	Night	–	–	–	–	–	–
H059	Day	–	–	–	0.2	–	–
	Night	–	–	–	–	–	–
H060	Day	–	–	–	0.5	–	–
	Night	–	–	–	–	–	–
H061	Day	–	–	–	0.5	–	–
	Night	–	–	–	–	–	–
H062	Day	–	–	–	0.6	–	–
	Night	–	–	–	–	–	–
H063	Day	–	–	–	0.4	–	–
	Night	–	–	–	–	–	–
H064	Day	–	–	–	0.1	–	–
	Night	–	–	–	–	–	–
H075	Day	–	–	–	0.5	–	–
	Night	–	–	–	–	–	–
H076	Day	–	–	–	0.4	–	–
	Night	–	–	–	–	–	–
H077	Day	–	–	–	0.2	–	–
	Night	–	–	–	–	–	–
H091	Day	–	–	–	0.3	–	–
	Night	–	–	–	–	–	–
H092	Day	–	–	–	0.1	–	–
	Night	–	–	–	–	–	–

Table 12-26 Summary of Exceedances Standard Operating Mode in East Wind Direction (90°)

Location	Period	Noise Exceedances (dB $L_{A90,}$ 10min), at various Standaridsed10m Height Wind Speed (m/s)					
		4	5	6	7	8	9
H025	Day	–	–	–	0.6	–	–
	Night	–	–	–	–	–	–
H026	Day	–	–	–	1	–	–
	Night	–	–	–	–	–	–
H028	Day	–	–	–	0.9	–	–
	Night	–	–	–	–	–	–
H057	Day	–	–	0.9	1.9	–	–
	Night	–	–	–	–	–	–
H058	Day	–	–	–	0.4	–	–
	Night	–	–	–	–	–	–
H059	Day	–	–	–	0.2	–	–
	Night	–	–	–	–	–	–
H060	Day	–	–	–	0.5	–	–
	Night	–	–	–	–	–	–
H061	Day	–	–	–	0.5	–	–
	Night	–	–	–	–	–	–
H062	Day	–	–	–	0.6	–	–
	Night	–	–	–	–	–	–
H063	Day	–	–	–	0.4	–	–
	Night	–	–	–	–	–	–
H064	Day	–	–	–	0.1	–	–
	Night	–	–	–	–	–	–
H075	Day	–	–	–	0.6	–	–
	Night	–	–	–	–	–	–
H076	Day	–	–	–	0.4	–	–
	Night	–	–	–	–	–	–
H077	Day	–	–	–	0.2	–	–
	Night	–	–	–	–	–	–
H088	Day	–	–	–	0.8	–	–
	Night	–	–	–	–	–	–

Table 12-27 Summary of Exceedances Standard Operating Mode in Southeast Wind Direction (135°)

Location	Period	Noise Exceedances (dB $L_{A90,}$ 10min), at various Standaridsed10m Height Wind Speed (m/s)					
		4	5	6	7	8	9
H001	Day	–	–	0.5	1.5	–	–
	Night	–	–	–	–	–	–
H002	Day	–	–	–	0.9	–	–
	Night	–	–	–	–	–	–
H003	Day	–	–	–	1	–	–
	Night	–	–	–	–	–	–

Location	Period	Noise Exceedances (dB $L_{A90,}$ 10min), at various Standaridsed10m Height Wind Speed (m/s)					
		4	5	6	7	8	9
H004	Day	–	–	0.1	1.1	–	–
	Night	–	–	–	–	–	–
H005	Day	–	–	–	0.6	–	–
	Night	–	–	–	–	–	–
H007	Day	–	–	–	0.4	–	–
	Night	–	–	–	–	–	–
H024	Day	–	–	–	1	–	–
	Night	–	–	–	–	–	–
H025	Day	–	–	0.6	1.6	–	–
	Night	–	–	–	–	–	–
H026	Day	–	–	1	2	–	–
	Night	–	–	–	–	–	–
H027	Day	–	–	0.1	1.1	–	–
	Night	–	–	–	–	–	–
H028	Day	–	–	1.1	2	–	–
	Night	–	–	–	–	–	–
H057	Day	–	–	–	0.3	–	–
	Night	–	–	–	–	–	–
H075	Day	–	–	–	0.4	–	–
	Night	–	–	–	–	–	–
H076	Day	–	–	–	0.4	–	–
	Night	–	–	–	–	–	–
H077	Day	–	–	–	0.2	–	–
	Night	–	–	–	–	–	–
H087	Day	–	–	–	0.2	–	–

Location	Period	Noise Exceedances (dB $L_{A90,}$ 10min), at various Standaridsed10m Height Wind Speed (m/s)					
		4	5	6	7	8	9
	Night	–	–	–	–	–	–
H088	Day	–	–	0.9	1.9	–	–
	Night	–	–	–	–	–	–
H098	Day	–	–	–	0.4	–	–
	Night	–	–	–	–	–	–
H090	Day	–	–	–	0.6	–	–
	Night	–	–	–	–	–	–

Table 12-28 Summary of Exceedances Standard Operating Mode in South Wind Direction (180°)

Location	Period	Noise Exceedances (dB $L_{A90,}$ 10min), at various Standaridsed10m Height Wind Speed (m/s)					
		4	5	6	7	8	9
H001	Day	–	–	1.6	2.6	–	–
	Night	–	–	–	–	–	0.2
H002	Day	–	–	1	2	–	–
	Night	–	–	–	–	–	–
H003	Day	–	–	1	2	–	–
	Night	–	–	–	–	–	–
H004	Day	–	–	1	2	–	–
	Night	–	–	–	–	–	–
H005	Day	–	–	0.5	1.5	–	–
	Night	–	–	–	–	–	–
H006	Day	–	–	–	0.9	–	–
	Night	–	–	–	–	–	–
H007	Day	–	–	0.1	1.1	–	–
	Night	–	–	–	–	–	–
H024	Day	–	–	–	1	–	–

Location	Period	Noise Exceedances (dB $L_{A90,}$ 10min), at various Standaridsed10m Height Wind Speed (m/s)					
		4	5	6	7	8	9
	Night	–	–	–	–	–	–
H025	Day	–	–	0.7	1.7	–	–
	Night	–	–	–	–	–	–
H026	Day	–	–	1.1	2.1	–	–
	Night	–	–	–	–	–	–
H027	Day	–	–	0.1	1.1	–	–
	Night	–	–	–	–	–	–
H028	Day	–	–	1.2	2.1	–	–
	Night	–	–	–	–	–	–
H087	Day	–	–	–	0.2	–	–
	Night	–	–	–	–	–	–
H088	Day	–	–	0.9	1.9	–	–
	Night	–	–	–	–	–	–
H098	Day	–	–	0.1	1.2	–	–
	Night	–	–	–	–	–	–
H090	Day	–	–	0.5	1.5	–	–
	Night	–	–	–	–	–	–

Table 12-29 Summary of Exceedances Standard Operating Mode in Southwest Wind Direction (225°)

Location	Period	Noise Exceedances (dB $L_{A90,}$ 10min), at various Standaridsed10m Height Wind Speed (m/s)					
		4	5	6	7	8	9
H001	Day	–	–	1.3	2.3	–	–
	Night	–	–	–	–	–	–
H002	Day	–	–	0.7	1.7	–	–
	Night	–	–	–	–	–	–

Location	Period	Noise Exceedances (dB $L_{A90,}$ 10min), at various Standaridsed10m Height Wind Speed (m/s)					
		4	5	6	7	8	9
H003	Day	–	–	0.7	1.7	–	–
	Night	–	–	–	–	–	–
H004	Day	–	–	0.8	1.8	–	–
	Night	–	–	–	–	–	–
H005	Day	–	–	0.3	1.3	–	–
	Night	–	–	–	–	–	–
H006	Day	–	–	–	0.6	–	–
	Night	–	–	–	–	–	–
H007	Day	–	–	–	1	–	–
	Night	–	–	–	–	–	–
H024	Day	–	–	–	0.3	–	–
	Night	–	–	–	–	–	–
H025	Day	–	–	–	0.9	–	–
	Night	–	–	–	–	–	–
H026	Day	–	–	0.4	1.4	–	–
	Night	–	–	–	–	–	–
H027	Day	–	–	–	0.3	–	–
	Night	–	–	–	–	–	–
H028	Day	–	–	0.4	1.3	–	–
	Night	–	–	–	–	–	–
H029	Day	–	–	0.5	–	–	–
	Night	–	–	–	–	–	–
H088	Day	–	–	0.2	1.2	–	–
	Night	–	–	–	–	–	–
H098	Day	–	–	–	1	–	–

Location	Period	Noise Exceedances (dB $L_{A90, 10min}$), at various Standaridsed10m Height Wind Speed (m/s)					
		4	5	6	7	8	9
	Night	–	–	–	–	–	–
H090	Day	–	–	0.2	1.2	–	–
	Night	–	–	–	–	–	–

Table 12-30 Summary of Exceedances Standard Operating Mode in West Wind Direction (270°)

Location	Period	Noise Exceedances (dB $L_{A90, 10min}$), at various Standaridsed10m Height Wind Speed (m/s)					
		4	5	6	7	8	9
H001	Day	–	–	0.6	1.6	–	–
	Night	–	–	–	–	–	–
H002	Day	–	–	0.1	1.1	–	–
	Night	–	–	–	–	–	–
H003	Day	–	–	0.1	1.1	–	–
	Night	–	–	–	–	–	–
H004	Day	–	–	–	0.9	–	–
	Night	–	–	–	–	–	–
H005	Day	–	–	–	0.4	–	–
	Night	–	–	–	–	–	–
H007	Day	–	–	–	0.1	–	–
	Night	–	–	–	–	–	–
H022	Day	–	–	–	0.4	–	–
	Night	–	–	–	–	–	–
H029	Day	–	–	1.2	–	–	–
	Night	–	–	–	–	–	–
H030	Day	–	–	0.6	–	–	–
	Night	–	–	–	–	–	–

Location	Period	Noise Exceedances (dB L_{A90}, 10min), at various Standaridsed10m Height Wind Speed (m/s)					
		4	5	6	7	8	9
H031	Day	–	–	0.5	–	–	–
	Night	–	–	–	–	–	–
H032	Day	–	–	0.5	–	–	–
	Night	–	–	–	–	–	–
H034	Day	–	–	–	1	–	–
	Night	–	–	–	–	–	–
H035	Day	–	–	–	1	–	–
	Night	–	–	–	–	–	–
H089	Day	–	–	–	0.3	–	–
	Night	–	–	–	–	–	–
H090	Day	–	–	–	0.4	–	–
	Night	–	–	–	–	–	–
H092	Day	–	–	–	0.7	–	–
	Night	–	–	–	–	–	–

Table 12-31 Summary of Exceedances Standard Operating Mode in Northwest Wind Direction (315°)

Location	Period	Noise Exceedances (dB L_{A90}, 10min), at various Standaridsed10m Height Wind Speed (m/s)					
		4	5	6	7	8	9
H022	Day	–	–	0.2	1.2	–	–
	Night	–	–	–	–	–	–
H029	Day	–	–	1.7	–	–	–
	Night	–	–	–	–	0.1	0.3
H030	Day	–	–	1.2	–	–	–
	Night	–	–	–	–	–	–
H031	Day	–	–	1.1	–	–	–

Location	Period	Noise Exceedances (dB $L_{A90,}$ 10min), at various Standaridsed10m Height Wind Speed (m/s)					
		4	5	6	7	8	9
	Night	–	–	–	–	–	–
H032	Day	–	–	1.3	–	–	–
	Night	–	–	–	–	–	0.3
H033	Day	–	–	0.8	–	–	–
	Night	–	–	–	–	–	–
H034	Day	–	–	1	2.2	–	–
	Night	–	–	–	–	–	0.1
H035	Day	–	–	0.6	1.8	–	–
	Night	–	–	–	–	–	–
H039	Day	–	–	–	0.3	–	–
	Night	–	–	–	–	–	–
H057	Day	–	–	–	0.2	–	–
	Night	–	–	–	–	–	–
H091	Day	–	–	–	0.1	–	–
	Night	–	–	–	–	–	–
H092	Day	–	–	–	1	–	–
	Night	–	–	–	–	–	–

Following review of the exceedances to the criteria in the various wind direction sectors, the following comments are presented.

In the prevailing wind direction (south west) exceedances are noted at sixteen NSLs. In the southeast wind direction the number of houses with exceedances is highest at nineteen houses. In the northwest wind direction, the number of houses is lowest, at twelve houses. It is reiterated that this initial review has considered a turbine operating in standard mode.

Wind turbines can be programmed to run in reduced modes of operation (or low noise modes) in order to achieve noise criteria during certain periods (i.e. day or night) and in specific wind conditions (i.e. wind speed and direction). The turbine technology that has been assumed for this assessment offers various low noise modes of operation which typically will have an associated energy output reduction.

Operating the turbines in reduced modes is generally referred to as curtailment and in the context of this EIAR is a proven effective mitigation to ensure noise limits are complied with. A detailed curtailment strategy matrix will be finalised as part of the detailed design for the selected turbine

technology to achieve the noise criteria at each of the noise sensitive locations. To demonstrate the principle of curtailment, a typical curtailment strategy matrix has been developed and is presented in Table 12-32 for south-westerly winds to address the exceedance listed in this wind direction sector. The required noise emission reductions to the relevant turbines are summarised in Table 12-32.

Table 12-32 Indicative Turbine Curtailment Matrix for South West Wind Direction

Wind Direction Sector	Period	Turbine Curtailment (dB) at Standarised Wind Speeds (m/s)					
		4	5	6	7	8	9
South	Day	–	–	T02: -0.5 T03: -4.5 T06: -5 T08: -2	T02: -0.5 T03: -4.5 T05: -4 T06: Off T08: -4	–	–
	Night	–	–	–	–	–	T06: -1

Assuming the implementation of the above or similar, it is not considered that a significant effect is associated with the operation of this development, since the predicted noise levels associated with the proposed development will be within the relevant best practice noise criteria curves for wind farms. As previously discussed, the following guidance is relevant for this assessment, "*Wind Energy Development Guidelines*" published by the Department of the Environment, Heritage and Local Government in 2006 and in the Department of Trade & Industry (UK) Energy Technology Support Unit (ETSU) publication "*The Assessment and Rating of Noise from Wind Farms*" (1996).

While noise levels at low wind speeds will increase due to the development the predicted levels will remain low, albeit a new source of noise will be introduced into the soundscape.

12.6.3.3 Site Roads

Considering that there is no significant traffic expected on site roads during the operational phase and the significant distances from any site road to the nearest NSL; there are no noise and vibration impacts anticipated from site roads during the operational phase.

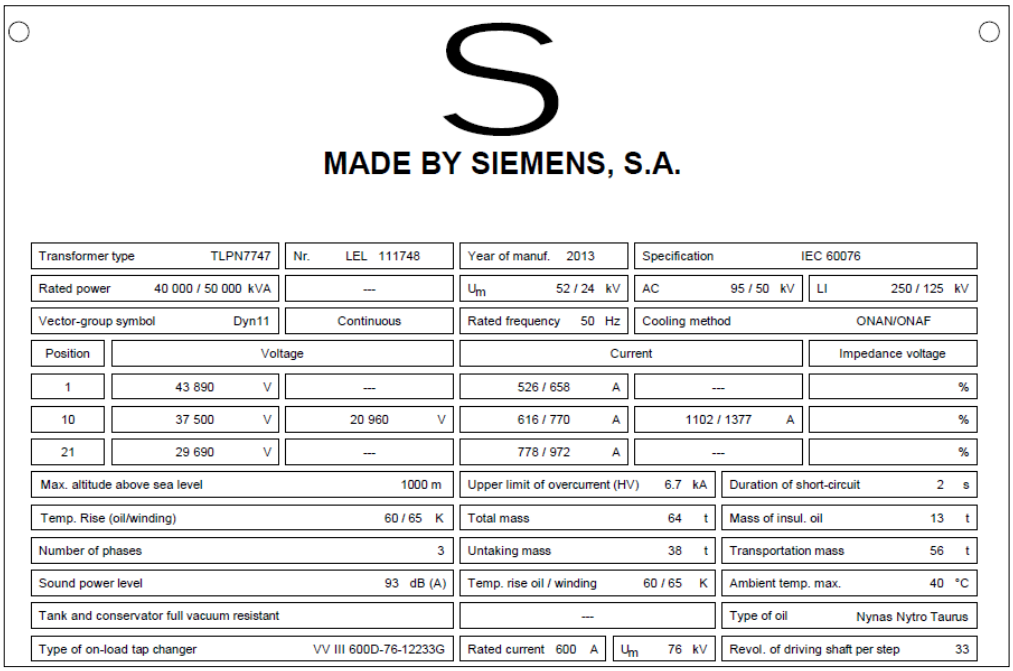
12.6.3.4 Substation

As previously stated, there are two substation options, only one of which will ultimately be constructed. The proposed substation locations are indicated in Table 12-33 below.

Table 12-33 Proposed Substation Locations

Substation Option Ref.	Irish Grid Co-ordinates	
	Eastings	Northing
Carrownagry	508977	669931
Cahermurphy	509501	668874

As part of the development the substation will be typically operational 24/7. The noise emission level associated with a typical substation that would support a development of this nature is the order of 93 dB(A) L_w as detailed in Figure 12-15.



MADE BY SIEMENS, S.A.

Transformer type	TLPN7747	Nr. LEL 111748		Year of manuf. 2013		Specification IEC 60076	
Rated power	40 000 / 50 000 kVA	---		U_m 52 / 24 kV		AC 95 / 50 kV	LI 250 / 125 kV
Vector-group symbol	Dyn11	Continuous		Rated frequency 50 Hz		Cooling method	ONAN/ONAF
Position	Voltage			Current			Impedance voltage
1	43 890 V	---		526 / 658 A		---	%
10	37 500 V	20 960 V		616 / 770 A		1102 / 1377 A	%
21	29 690 V	---		778 / 972 A		---	%
Max. altitude above sea level	1000 m			Upper limit of overcurrent (HV) 6.7 kA		Duration of short-circuit 2 s	
Temp. Rise (oil/winding)	60 / 65 K			Total mass 64 t		Mass of insul. oil 13 t	
Number of phases	3			Untaking mass 38 t		Transportation mass 56 t	
Sound power level	93 dB (A)			Temp. rise oil / winding 60 / 65 K		Ambient temp. max. 40 °C	
Tank and conservator full vacuum resistant				---		Type of oil Nynas Nytro Taurus	
Type of on-load tap changer	VV III 600D-76-12233G			Rated current 600 A	U_m 76 kV	Revol. of driving shaft per step 33	

Figure 12-15 Statement of L_w for Typical Sub Station Used for Assessment

An iteration of the noise model has been developed to consider the expected noise level from the plant at the nearest noise sensitive locations to the proposed substation. The predicted noise levels at the closest 10 no. receivers are presented in Table 12-34 and Table 12-35.

Table 12-34 Predicted Substation Noise Levels (Carrownagry Option)

House ID	Height (m)	Predicted LAeq,T dB
H001	4	19
H003	4	19
H002	4	19
H004	4	18
H090	4	18
H005	4	17
H089	4	17
H006	4	17
H007	4	16
H028	4	11

Table 12-35 Predicted Substation Noise Levels (Cahermurphy Option)

House ID	Height (m)	Predicted LAeq,T dB
H029	4	25

House ID	Height (m)	Predicted LAeq,T dB
H030	4	23
H031	4	22
H032	4	22
H033	4	20
H034	4	19
H035	4	17
H092	4	12
H012	4	11
H015	4	11

The worst case predicted level is expected to be the order of 22-25dB(A) at H029, H030, H031 and H32. These noise levels will be in line with or less than prevailing background noise levels. At other locations the predicted level is 20dB or less. 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.

The operation of the substation will not produce any significant vibration, therefore at the distances between either option and the nearest house (>200m), no vibration effects from the substation are expected.

12.6.3.5 Operational Phase Mitigation Measures

An assessment of the operation noise levels has been undertaken in accordance with best practice guidelines and procedures as outlined in Section 12.4.2 of this Chapter. The findings of the assessment confirmed that the predicted operational noise levels will be within the relevant best practice noise criteria curves for wind farms at all locations. Therefore, beyond a curtailment scheme such as that outlined in section 12.6.3.2 , no additional mitigation measures are required.

If alternative turbine technologies are considered for the site an updated noise assessment will be prepared to confirm that the noise emissions associated with them will comply with the noise criteria curves as per best practice guidance outlined in Section 12.4.2 and/or the relevant operational criteria associated with the grant of planning for the 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.

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 *Procedure for the assessment of low frequency noise complaints, Revision 1, December 2011.*

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, *A Method for Rating Amplitude Modulation in Wind Turbine Noise* (August 2016) or subsequent revisions (August 2016).

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.

12.6.3.5.1 *Monitoring*

Commissioning noise surveys are recommended 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 the relevant section of this report be repeated with consideration of the guidance outlined in the IoA GPG and Supplementary Guidance Note 5.

12.6.4 Decommissioning Phase

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.

Considering that in all aspects of the construction and decommissioning the predicted noise levels are expected to be below the appropriate Category A value (i.e. 65dB $L_{Aeq,T}$) at current noise sensitive locations for the decommissioning phase . The resulting noise and vibration impacts are not significant.

12.6.4.1 Decommissioning Phase Mitigation

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 12.6.2.

12.7 Description of Residual Effects

12.7.1 Do-Nothing Scenario

If development were not to proceed then the existing noise environment will remain largely unchanged considering the existing and permitted wind turbine developments in the area. In areas where traffic noise is a significant source in the noise 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.

12.7.2 Construction and Decommissioning Phases

During the construction and decommissioning phases 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 effect is kept to a minimum.

With respect to the EPA's criteria for description of effects, in terms of these construction activities, the potential worst-case associated effects at the nearest noise sensitive locations associated with the various elements of the construction phase are described below.

12.7.2.1 General Construction – Turbines, Hardstanding, Met Mast and Construction Compound

The predicted construction noise and vibration effects associated with on-site construction activities including are temporary and not significant and is summarised as follows:

Quality	Significance	Duration
Negative	Slight	Short-term

12.7.2.2 Construction of Internal Roads (including Tree Felling and laying of underground cables)

The predicted worst-case noise and vibration effects associated with proposed internal construction operations at NSL's are summarised as follows:

Quality	Significance	Duration
Negative	Moderate	Temporary

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.

At all other noise sensitive locations, the following effect is associated with the internal construction of roads:

Quality	Significance	Duration
Negative	Slight	Temporary

12.7.2.3 Borrow Pit Activity

The predicted worst-case noise and vibration effects associated with proposed borrow pit construction at NSL's are summarised as follows:

Quality	Significance	Duration
Negative	Slight	Temporary

12.7.2.4 Substation Construction

The predicted worst-case noise and vibration effects associated with proposed substation construction at NSL's are summarised as follows:

Quality	Significance	Duration
Negative	Slight	Temporary

12.7.2.5 Grid Connection Construction

The predicted worst-case noise and vibration effects associated with proposed grid connection construction at NSL's are summarised as follows:

Quality	Significance	Duration
Negative	Moderate	Temporary

The above effects should be considered in terms that the effect is variable and that this assessment considers six locations with the greatest potential impact.

At all other noise sensitive locations, the following effect is associated with the internal construction of roads:

Quality	Significance	Duration
Negative	Slight	Temporary

12.7.2.6 Construction Traffic

The effects associated with the overall noise levels from construction traffic is summarised as follows, for the worst-case phase of the construction:

Quality	Significance	Duration
Negative	Moderate	Temporary

12.7.3 Operational Phase

12.7.3.1 Noise

12.7.3.1.1 *Wind Turbine Noise*

The predicted noise levels associated with the proposed development will be within best practice noise criteria curves recommended in Irish guidance '*Wind Energy Development Guidelines for Planning Authorities'* it is not considered that a significant effect is associated with the development.

While noise levels at low wind speeds will increase due to the development and specifically the operation of the turbines, the predicted levels will remain low, albeit new sources of noise will be introduced into the soundscape.

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-term

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 locations assessed here the effect of the operational turbines are as follows:

Quality	Significance	Duration
Negative	Slight	Long-term

12.7.3.1.2 *Substation Noise*

The associated effect from the day to day operation of the substation is summarised as follows:

Quality	Significance	Duration
Negative	Not significant	Long-term

12.7.3.2 Vibration

There are no expected sources of vibration associated with the operational phase of the proposed development, from either the wind turbines nor the substation. In relation to of vibration the associated effect is summarised as follows:

Quality	Significance	Duration
Negative	Imperceptible	Long-term

12.7.4 Cumulative Effects

This assessment of wind turbine noise presented in this chapter has included 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 12.4.2.1.

Other potential sources of noise in the cumulative context are the ongoing surrounding commercial forest management activities on Coillte-owned lands including felling and replanting of trees. Noise from commercial forest management will be managed in line with the operational conditions of the felling licence and therefore no long-term cumulative noise impacts are anticipated between the

proposed development in combination with commercial forestry activities. It is noted that all general forestry activity will be curtailed on the site during the construction of the proposed development.

The replanting lands are located in counties Roscommon, Clare, Galway and Cavan and therefore are not likely to contribute to potential cumulative impacts with the proposed wind farm development in terms of noise impacts. The potential direct, indirect and cumulative impacts of replanting lands on noise has been assessed in the Section 10 of Appendix 4-3 Assessment of Forestry Replacement Lands.

13. LANDSCAPE AND VISUAL

13.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) is a landscape and visual impact assessment (LVIA) of the proposed Cahermurphy Two Wind Farm development. The emphasis in this chapter is on the likely significant effects of the proposal. It includes a description of 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 of County Clare 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.

The site is on the western edge of an elevated plateaux of land over 100 metres in elevation that forms an area of upland in central West-Clare. The land cover of the site comprises a mix of coniferous forestry, peatland and rough pasture.

The majority of the proposed development site, and nine of the ten proposed wind turbines are situated within an area designated as a 'Strategic Area' for Wind Farm Development in the Clare Wind Energy Strategy. One turbine falls within an area designated as 'Acceptable in Principle'. The proposed site is largely located in the Sliabh Callan Uplands LCA (landscape character area), which is recognised as having an overall Medium to Low sensitivity to wind farm developments, in which "large" sized wind farms are deemed to be appropriate. Although a portion of the proposed site and two proposed turbines are located in the Malbay Coastal Farmland LCA, which is considered to have a higher overall sensitivity to wind farm developments, those two turbine locations are also classified as being 'Strategic Areas' for wind farm development in the Clare Wind Energy Strategy.

Wind energy developments are now an integral part of the west Clare landscape, having been guided and directed by a plan-led approach over the last decade. The proposed development is intended to further deliver on the targets that have been set by the Clare Wind Energy Strategy for the specific policy area and landscape character areas in which the proposed development site is located.

13.1.1 Statement of Authority

Sections of this chapter were initially drafted by Megan Geaney, a graduate Landscape and Visual Impact Professional. Megan has a Bachelors in Geography and English and a Masters in Planning and Sustainable Development. Megan was aided by Brian Keville and Joanna Mole who went on to further refine and finalise the initial draft after Megan took up another job and moved on from MKO. The mapping for this LVIA was undertaken by Audrey Williams, who holds a Bachelor of Landscape Architecture (BLA) qualification and has two years professional working experience in both private and educational teaching practices from Canada, Sweden and Ireland. Brian Keville is a qualified Environmental Scientist and environmental consultant with 20 years' experience of EIA and LVIA. Joanna is a Landscape and Visual Impact Assessment Specialist and Chartered Landscape Architect with MKO and has over 15 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, 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. Joanna holds chartered membership of the British Landscape Institute since 1998 and has been an examiner for British Landscape Institute professional practice exam.

13.2 The Proposed Development

13.2.1 Project Description

A full description of the proposed development is provided in Chapter 4 of this EIAR, but in summary, the proposed development will comprise the construction of 10 No. wind turbines and all associated works. The proposed turbines will have a maximum blade tip height of up to 170 metres. For the purposes of this LVIA, the following project components have been considered:

i. *Construction of up to 10 No. wind turbines with a maximum overall blade tip height of up to 170 metres and associated hard stand areas;*
ii. *1 no. permanent Meteorological Mast with a maximum height of up to 100 metres;*
iii. *1 no. 38kV permanent electrical substation which will be constructed at one of two possible locations on site: either Option A in Carrownagry South townland or Option B in Cahermurphy townland. The electrical substation will have 1 no. control building with welfare facilities, all associated electrical plant and equipment, security fencing, all associated underground cabling, waste water holding tank and all ancillary works;*
iv. *All associated underground electrical and communications cabling connecting the turbines to the proposed on-site substation;*
v. *All works associated with the connection of the proposed wind farm to the national electricity grid via an underground cable to the existing Booltiagh 110kV substation;*
vi. *Upgrade of existing tracks, roads and provision of new site access roads and hardstand areas;*
vii. *Junction access road works;*
viii. *2 no. borrow pits;*
ix. *1 no. temporary construction compound;*
x. *Site Drainage;*
xi. *Forestry Felling to facilitate construction and operation of the proposed development;*
xii. *All associated and ancillary site development works.*

This application is seeking permission for a 30-year operational life from the date of commissioning of the wind farm.

To make way for the proposed development, it will be necessary to permanently fell 34.11 hectares of commercial forestry. The replanting of 34.11 hectares will also be necessary, across sites located in Counties Clare, Cavan, Galway and Rocommon, which have been assessed in full elsewhere in this EIAR.

For the purposes of this LVIA, every individual element of the proposed development has been considered in terms of its potential for landscape or visual effects, with some more likely to have a greater potential for landscape and visual impacts/effects than others. In such LVIAs, a large emphasis is placed on assessing the visibility of, and the potential for visual impacts/effects arising from the proposed wind turbines.

The exact make and model of the turbine will be dictated by a competitive tender process, but will not exceed the maximum 170-metre turbine size envelope set out above. The wind turbines to be installed will be conventional three-blade turbines, geared to ensure the rotors of all turbines rotate in the same direction at all times. The turbines will be off-white or light grey in colour and a matt finish.

13.2.2 'Do-Nothing' Scenario

In the 'Do Nothing' scenario, the Proposed Development would not be constructed and the opportunity to harness the wind resource for renewable energy will be lost. The existing land-use of low-intensity agriculture and commercial forestry will continue along with the now-operational three-turbine Cahermurphy Wind Farm. The permitted additional (fourth) turbine on the adjacent

Cahermurphy site will likely be constructed within the lifetime of its planning permission. Commercial forestry operations will likely continue on a 35-40 year rotation, with felling and replanting of sub-compartments on maturity.

In the absence of the proposed development, a significant area of the County Clare's Strategic Area for wind development, as designated by the County Clare Wind Energy Strategy, will remain undeveloped, which will prevent the potential of this area from being harnessed as had been envisaged by the County Clare Wind Energy Strategy and the Clare County Development Plan 2017-2023.

13.2.3 Mitigation by Good Design

Through the iterative project design process, informed by early-stage impact assessment work, landscape modelling, zone of theoretical visibility (ZTV) mapping and photomontage preparation, every effort has been made to bring forward the optimum design for the project now proposed 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:

- All turbines are located in either a 'Strategic Area' for Wind Farm Development (9/10) or in an area where wind energy developments are designated as 'Acceptable in Principle' (1/10).
- 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 of the project has been designed to be in keeping with the existing turbines located in the vicinity of the development which are at a higher tip height or base elevation to the proposed development.
- All turbines have been located greater than 4 times the tip height from residential developments in order to protect residential visual amenity.
- The internal site road layout makes use of the existing tracks wherever possible (to be upgraded for the delivery of wind turbine components), to minimise the requirement for new tracks within the site; and
- Felling of existing coniferous plantation is predominantly limited to keyhole felling in localised parts of the site, in keeping with existing practices in the commercial forestry plantation on-site.

During the initial site selection process, landscape sensitivity was identified as a key constraint and so landscapes considered to be less sensitive were preferred over sites with more sensitivity to change.

During site design process, the potential visibility of the project was reduced by removing two turbines located to the north west of the site which would have extended the spatial extent of the project and the number of visual receptors.

The site location and current layout minimises the theoretical potential for visibility and the site visits and assessment tools used in this chapter show that the actual visibility is far less than the theoretical visibility would suggest. Where visibility does occur, the design is in accordance with best practice and a coherent project, sympathetic to its neighbouring wind turbines, is evident.

The existing/permitted Cahermurphy Wind Farm is located immediately to the east of the proposed site, demonstrating the location has already been deemed appropriate for wind farm development. Three of the four permitted turbines in the Cahermurphy Wind Farm are already operational with the fourth awaiting a grid connection offer/allocation before being constructed.

13.3 Methodology

13.3.1 LVIA Study Area

For the purposes of this EIAR, where the 'proposed development site' or 'the site' is referred to, this relates to the primary study area for the proposed development as delineated in in Figure 1-1. This total area measures approximately 538 hectares. The landscape and visual impact assessment study area extends over a wider study areas. The LVIA study area has been chosen as a 20 kilometres radius from the outermost proposed turbines for visual and landscape effects and for effects on landscape character.

13.3.2 Structure

This section briefly outlines the methodology used to undertake the landscape and visual impact assessment of the proposed development, and a more detailed description of the methodology is outlined in detail in Appendix 13.1, which outlines the guidance used in the preparation of each section. There are five main sections to this assessment as follows:

1. *Methodology*
2. *Landscape policy context*
3. *Landscape baseline*
4. *Visual Baseline*
5. *Likely or Significant Landscape and Visual Effects*

13.3.3 Guidelines

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.

This 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 Housing, Planning and Local Government, Dublin (December 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)
- EPA Guidelines on the information to be contained on Environmental Impact Statements (EPA 2002)
- EPA Advice Notes on Current Practice in the preparation of Environmental Impact Statements (EPA, 2003).
- Spatial Planning for Onshore Wind Turbines – natural heritage considerations (Scottish Natural Heritage, 2015)
- Guidelines on the Information to be contained in Environmental Impact Assessment Reports – Draft August 2017 '(EPA 2017).
- Cumulative Impact of Wind Turbines on Landscape and Visual Amenity (Carmarthenshire County Council, Wales, 2013)
- Clare County Development Plan 2017–2023 (Clare County Council, 2017)
- Landscape Character Assessment of County Clare (Clare County Council, 2004)
- Clare Wind Energy Strategy (Clare County Council, 2017)

13.3.4 Methodology

A desk study of relevant policy, guidelines and legislation was first undertaken to identify policies and guidelines on wind energy, landscape and landscape character, designated landscapes and protected views, both at national and local level.

The baseline landscape is then described in terms of site location, topography, landform, drainage, connectivity, land use, land cover, landscape character and other wind farms.

The visual baseline was then described by way of a zone of theoretical visibility analysis, views towards the site and visual receptors.

Finally, the impact assessment is undertaken by way of assessment of landscape and visual effects, including cumulative effects.

The potential significant effects of the proposed development in terms of visual and landscape effects are informed by the site visits, ZTV, wireframes and photomontages. The methodology includes clearly documented methods used to arrive at each assessment finding. These include consideration of landscape and visual sensitivity balanced with the magnitude of the effect to arrive at an assessment of the significance of likely significant landscape and visual effects. Further details on the impact assessment methodology and a description of terminology used are presented in Appendix 13.1.

Field visits were undertaken throughout 2019 and in 2020 in the preparation of this LVIA, to assess the landscape character and visual elements both in the EIAR study area and in the wider landscape up to 20km from the site.

The cumulative LVIA follows the same structure as the assessment of landscape and visual effects relating to the proposed development. Cumulative ZTV maps are produced which include the other wind farms. In addition, the photomontages include other projects, most notably the existing and permitted wind farms, and the cumulative landscape and visual effects are assessed separately. Other non-wind farm developments considered in the planning history review undertaken in Section 2.5.1 of this EIAR were also considered for the purposes of this LVIA, but deemed not to have the potential to give rise to cumulative landscape and visual effects, given their significantly smaller scale when compared to the proposed wind turbines. The cumulative assessment has prioritised the assessment the proposed development in combination with other proposed, permitted or operational wind farm developments.

For the purposes of this EIAR, various types and sizes of wind turbines have been selected in various sections of the EIAR to undertake the necessary assessments. For the purposes of this LVIA, a turbine type with the parameters set out in Table 13-1 Wind turbine dimensions assessed for the purposes of LVIA below has been assessed. Turbines with slightly different rotor diameter and hub height configurations may be used within the proposed blade tip height envelope of 170m as they will make no appreciable difference from an LVIA perspective.

Table 13-1 Wind turbine dimensions assessed for the purposes of LVIA

Turbine Parameter	Dimension
Maximum blade tip height	170m
Rotor diameter	130m
Half-blade height	137.5m
Hub Height	105m

13.3.5 Scope

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 considered to be not material to this LVIA and scoped out of the assessment:

- Effects on landscape and visual receptors that have minimal or no theoretical visibility and/or very distant visibility, and are therefore will not be subject to significant effects;
- Effects on designated landscapes beyond a 20km radius from the proposed development, from where potential significant effects on key characteristics and/or special qualities or views, are judged not to occur;
- Effects on landscape character beyond a 20km radius from the proposed development, where it is judged that potential significant effects on landscape character are not to occur;
- Effects on visual receptors beyond a 20km radius from the proposed development, where it is judged that potential significant effects will not to occur;
- Cumulative landscape effects and cumulative visual effects beyond a 20km radius from the proposed development, where it is judged that potential significant effects on landscape character will not occur;
- Visual effects during the construction phase and cumulative landscape and visual effects during the construction phase given their temporary duration;
- All potential effects occurring during decommissioning of the proposed development given their temporary duration.

13.4 Landscape Policy Context

This sub-section reviews the Wind Energy Development Guidelines (DoEHLG, 2006) and the policies and objectives of various planning policy documents relating to landscape, planning and the locational siting of wind farms, as they relate to the site of the proposed development.

13.4.1 Clare Wind Energy Strategy

The Clare Wind Energy Strategy (CWES) forms Volume 5 of the Clare County Development Plan 2017-2023, and divides County Clare into four areas with regard to their capacity to accommodate wind energy developments. These areas are:

- Strategic Areas
- Acceptable in Principle Areas
- Open for Consideration Areas
- Not Normally Permissible Areas

Figure 13-1 Wind Energy Designations map from CWES 2017-2023, with Cahermurphy site location shown in red

The majority of the proposed development site, and nine of the ten proposed wind turbines are situated within an area designated as a 'Strategic Area' for Wind Farm Development. One turbine falls within an area designated as 'Acceptable in Principle', as shown in Figure 13-2 below.

Specific objectives are included in the CWES pertaining to each of the wind strategy areas. Special objective "WES Eight" relates to 'Strategic Areas', and describes these as:

> *"These key areas are considered to be eminently suitable for wind farm development and are of strategic importance because of;*
>
> - *Good / excellent wind resources*
> - *Access to grid*
> - *Distance from properties and*
> - *Outside any Natura 2000 sites Projects within these areas must:*

- *Demonstrate conformity with existing and approved wind farms to avoid visual clutter.*
- *Be designed and developed in line with the Wind Energy Development Guidelines, Guidelines for Planning Authorities (DoEHLG, 2006) in terms of siting, layout and environmental studies.*
- *Provide a Habitats Directive Assessment under Article 6 of the Habitat Regulations if the site is located in close proximity to a Special Area of Conservation or Special Protection Area.*
- *Be developed in a comprehensive manner avoiding the piecemeal development of the areas designated as 'strategic'.*

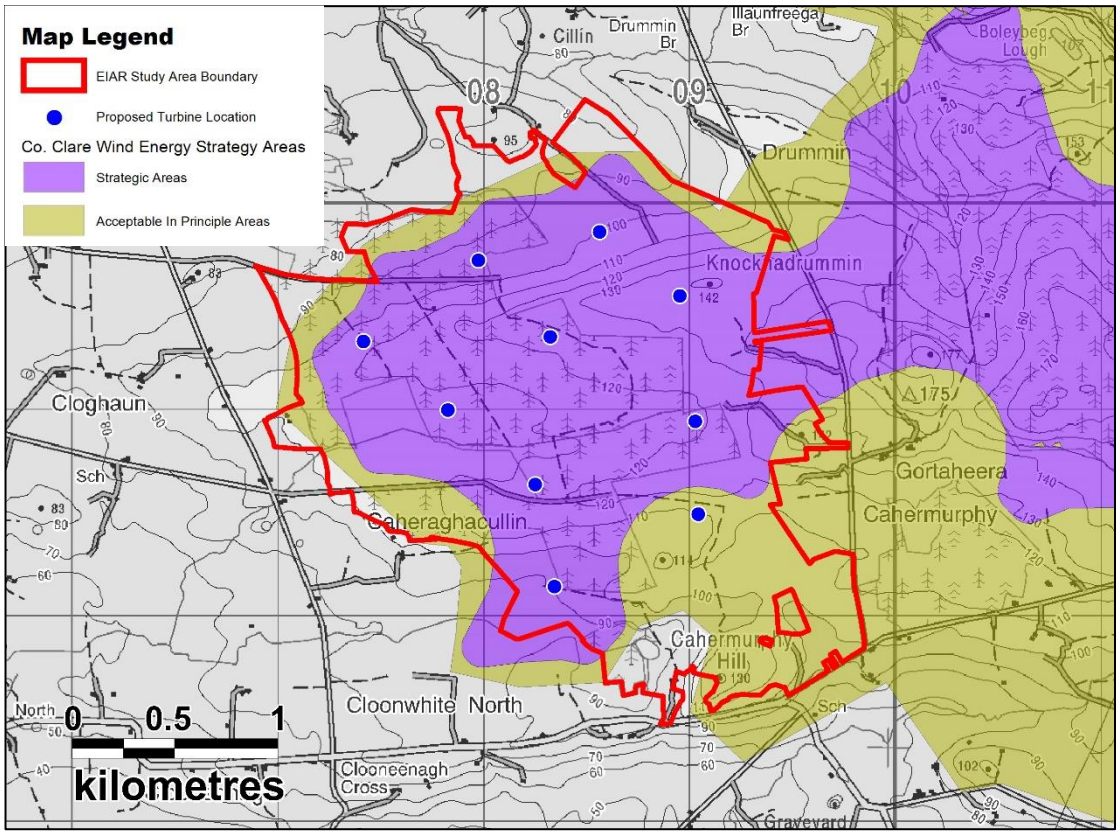


Figure 13-2 EIAR Study Area and proposed turbine locations relative to Clare Wind Strategy Areas

Special objective "WES Eight" of the CWES includes a target of 400 MW of wind energy generation from strategic areas. To-date, only 144.78MW of wind energy projects have been permitted or constructed in the areas designated as Strategic Areas. The proposed development, in seeking to locate nine of the ten proposed turbines in Strategic Areas, would further deliver on the stated target on the CWES by delivering a further 43.2MW, or 10.8% of the County's target for Strategic Areas.

Special objective "WES Nine" of the CWES relates to 'Acceptable in Principle' Areas, and describes these as:

"*These areas are considered suitable for wind farm development because of:*

- *Sufficient wind speeds,*
- *Access to grid network, and*
- *Established patterns of inquiries."*

Special objective "WES Nine" of the CWES includes a target of 150 MW of wind energy generation from Acceptable In Principle areas. To-date, only 99.7MW of wind energy projects have been permitted or constructed in the areas designated as Acceptable in Principle Areas. The proposed

development, in seeking to locate one of the ten proposed turbines in Acceptable in Principle Areas, would further deliver on the stated target on the CWES by delivering a further 4.8 MW, or 3.2% of the County's target for Acceptable in Principle Areas.

Section 4 of the CWES provides general advice on the landscape capacity for wind energy developments across the county's different landscape character areas (LCAs). The LCAs will be described in Section 13.4.3 further below, but the site of the proposed development lies partially across two LCAs, with eight of the proposed ten turbines locating within the LCA 17 'Slieve Callan Uplands' and the remaining two proposed turbines within the LCA 20 'Malbay Coastal Farmland'.

Table 13-2 Strategic guidance on landscape capacity for wind energy (extract from Table 4a of CWES)

LCA	Overall Sensitivity to Wind Farm Develop-ments	Appro-priate size of wind farms (turbines numbers)	Capacity	LCTs in Co. Clare. LCA and corres-ponding LCTs in 2006 Planning Guidelines	Cumulative Advice from 2006 Planning Guidelines
Sliabh Callan **(LCA 17)** This LCA encompasses upland hills and slopes of Sliabh Callan and Ben Dash	Medium to Low	Large	The rolling hills, low settlement, extensive plantations reduce the overall sensitivity of this LCA to wind farm development. The area could accommodate a number of large or medium wind farms subject to careful siting to avoid significant impacts on skylines. Potential Renewable Energy Generation for this area is 250 MW (Limerick Clare Energy Agency).	Upland Hills Moorland Hills Planning Guidelines: Moorland Mountain	Acceptable, depending on topography as well as siting and design of wind energy developments involved.
Malbay Coastal Farmland **(LCA 20)**	High	Small	The open exposed character of this area and its significance as a tourism and recreational area increases the overall sensitivity. Large or medium wind farms would be highly visible particularly close to the coastal area. There may be some limited capacity to accommodate small wind farms further east where the landform is more undulating.	Not defined in Co. Clare LCA. Planning Guidelines: Hilly and Flat Farmland	Important wind development not perceived to visually dominate. Visibility of two or more wind developments is usually acceptable.

As outlined in Figure 13-3, the proposed site is largely located in the Sliabh Callan Uplands LCA, which is recognised as having an overall Medium to Low sensitivity to wind farm developments, in which "large" sized wind farms are deemed to be appropriate, as indicated in Table 13-2 above. Although a portion of the proposed site and two proposed turbines are located in the Malbay Coastal Farmland LCA, which is considered to have a higher overall sensitivity to wind farm developments, those turbine locations are also classified as being 'Strategic Areas' for wind farm development in the CWES, which demonstrates the acceptability of the location of the two proposed turbines, particularly as part of a larger development.

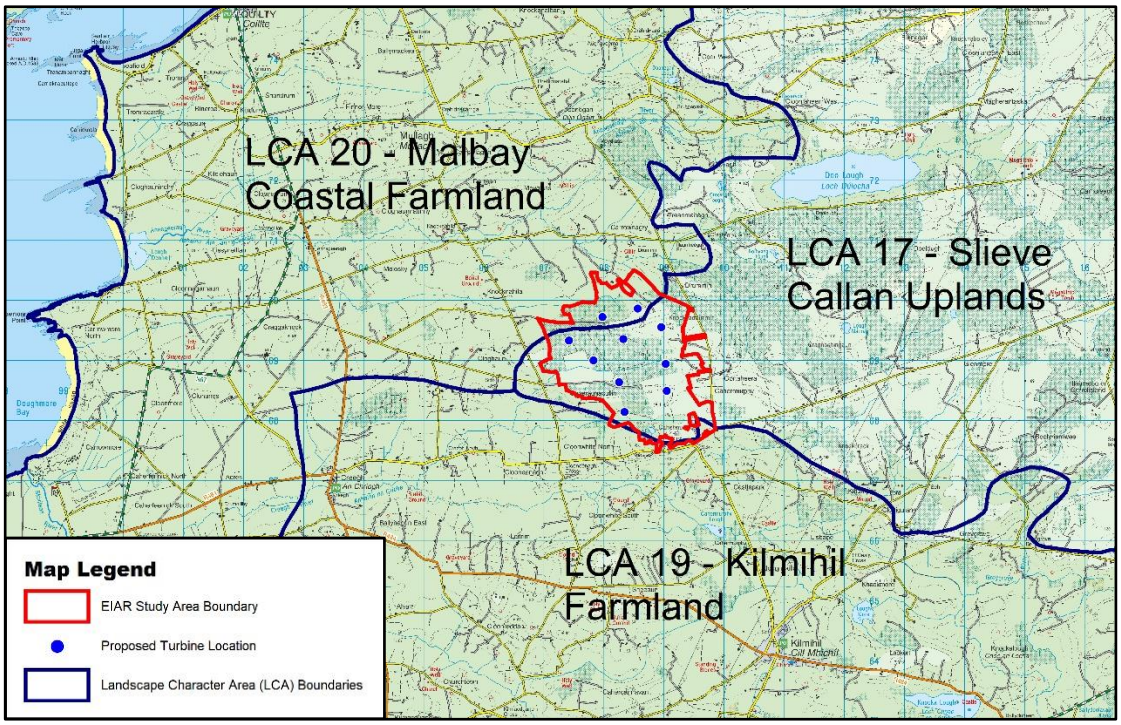


Figure 13-3 Landscape Character Area (LCA) boundaries and proposed turbine locations

Section 1.4 of the CWES defines wind farm project size, and on the basis of the definitions outlined below, the proposed ten-turbine development would be categorised as a 'Medium' size project:

- Small – 1 to 5 turbines
- Medium – 6 to 10 turbines
- Large – 11 to 25 turbines
- Very Large – more than 25 turbines

In the CWES, landscape sensitivity is rated on a five-point scale as follows:

- High
- Medium to High
- Medium
- Medium to Low
- Low

The CWES provides further insights in Annex B on the key landscape and visual characteristics and values of the LCAs within the 'Strategic Areas'. The relevant information for LCA 17 and LCA 20 which the site of the proposed development lies within, is extracted from the CWES into Table 13-3 and Table 13-4 below.

Table 13-3 LCA 17 – Sliabh Callan Uplands. Key landscape and visual characteristics and values, and sensitivity to wind energy development (extract from Annex B of CWES)

Key Landscape and Visual Characteristics and Values		Sensitivity to Wind Energy Development	
Scale	Medium to large	**Overall Sensitivity**	Medium to Low
Landform	Upland area of hills and plateaux broad valleys in between.	**Very large/large wind farm**	Not defined in Co. Clare LCA.

Key Landscape and Visual Characteristics and Values		Sensitivity to Wind Energy Development	
Landcover	Mix of pasture with increased forestry on upper soils.	**Medium wind farm:**	Low
Enclosure	Upper slopes more open with increased enclosure though hedgerows on lower slopes	**Small wind farm:**	Low
Human Influence	Agricultural activity, afforestation, scattered settlement		
Landscape Quality	Good to moderate		
Wilderness and Tranquillity	Increasingly remote further north.		
Natural and Cultural Heritage Features	NHA designation at Sliabh Callan		
Amenity and Recreation	Limited facilities		
Capacity Assessment	The rolling hills, low settlement, extensive plantations reduce the overall sensitivity of this LCA to Wind farm development. The area could accommodate large or medium wind farms subject to careful siting to avoid significant impacts on skylines.		

With the overall sensitivity of LCA 17 to wind energy development being rated as Medium to Low, the landscape sensitivity of the Sliabh Callan Uplands, where eight of the ten proposed turbines are located, is deemed to be in the second lowest category of landscape sensitivity in the whole county.

Table 13-4 LCA 20 – Malbay Coastal Farmland. Key landscape and visual characteristics and values, and sensitivity to wind energy development (extract from Annex B of CWES)

Key Landscape and Visual Characteristics and Values		Sensitivity to Wind Energy Development	
Scale	Medium	**Overall Sensitivity**	High
Landform	Generally low-lying sloping coastal landform	**Very large/large wind farm**	High

Key Landscape and Visual Characteristics and Values		Sensitivity to Wind Energy Development	
Landcover	Principally open with limited enclosure	**Medium wind farm:**	High
Enclosure	Land use of pasture, coastal habitats and small pockets of coniferous forestry	**Small wind farm:**	Medium
Human Influence	Evident through recreational and tourism facilities, historic monuments such as promontory forts and agricultural activity		
Landscape Quality	Good to moderate		
Wilderness and Tranquillity	Proximity to Atlantic creates a sense of wilderness in certain locations		
Natural and Cultural Heritage Features	habitats including sand dues are designated as SAC's. Megalithic tombs and promontory forts		
Amenity and Recreation	Important tourism and recreation along the coast		
Capacity Assessment	The open exposed character of this area and its significance as a tourism and recreational area increases the overall sensitivity. Large or medium wind farms would be highly visible particularly close to the coastal area. There may be some limited capacity to accommodate small wind farms further east where the landform is more undulating.		

Although the overall sensitivity of LCA 20 to wind energy development being rated as High, the portion of the Malbay Coastal Farmland LCA where the remaining two of the ten proposed turbines are located was still deemed to be a Strategic Area for wind farm development in the CWES. The two turbines are located on the eastern edge of Malbay Coastal Farmland LCA (LCA 20), immediately adjacent to the Slievecallan Uplands LCA (LCA 17) in an undulating landscape more in keeping with LCA 17 than the broader LCA 20. The area where the two turbines are proposed was still classified as a "Strategic Area" for wind farm development in the Clare WES in the knowledge of the area's High sensitivity classification.

13.4.2 Clare County Development Plan 2017-2023

The Clare County Development Plan 2017-2023 (CCDP) was consulted to identify relevant landscape designations and policies, and those relevant to landscape are contained in Chapter 13 of the CCDP.

13.4.2.1 Living Landscapes

The CCDP identifies landscape character types and landscape character areas. Section 13.3 of the CCDP identified three types of areas or "Living Landscapes":

- Settled Landscapes – areas where people live and work
- Working Landscapes – intensively settled and developed areas within Settled Landscapes or areas with a unique natural resource
- Heritage Landscapes – areas where natural and cultural heritage are given priority and where development is not precluded but happens more slowly and carefully

The proposed site is located within a Settled Landscape, and Objective 13.2 of the CCDP is of relevance as it sets out the objective of the CCDP with regard to the Settled Landscape areas as follows:

"To permit development in areas designated as 'settled landscapes' that sustain and enhance quality of life and residential amenity and promote economic activity subject to:

- *Conformity with all other relevant provisions of the plan and the availability and protection of resources*
- *Selection of appropriate sites in the first instance within this landscape, together with consideration of the details of siting and design which are directed towards minimising visual impacts*
- *Regard being given to avoiding intrusions on scenic routes and on ridges or shorelines*

Developments in these areas will be required to demonstrate:

- *That the site has been selected to avoid visually prominent locations*
- *That the site layouts avail of existing topography and vegetation to reduce visibility from scenic routes, walking trails, water bodies, public amenities and roads,*
- *That design for buildings and structure reduce visual impact through careful choice of forms, finishes and colours, and that any site works seek to reduce visual impact.*

The proposed development clearly conforms with other relevant provisions of the CCDP in that the site is located primarily in an area identified as a 'Strategic Area' for wind farm development. The site's classification as a 'Strategic Area' was a key consideration in the selection of the site as being deemed appropriate for the intended use. Although it will be visible from some parts of designated scenic routes in the surrounding area, the visual impact assessment further below will demonstrate that the visual impact from the scenic route will not be significant.

13.4.2.2 Scenic Routes

The CCDP recognises the need to protect and conserve views adjoining public roads where these views are of high amenity value. It does so through the designation of scenic routes, as outlined in maps in Volume 2 (Map C), Map 13A and Appendix 5 of the CCDP. There are five scenic routes within the LVIA study area as shown on Figure 13-4 and listed in Table 13-5 below.

Table 13-5 CCDP Scenic Routes within 20 kilometre LVIA study area (Co. Clare), as shown on Figure 13-4.

Map Ref.	View
SR1	Coast Road from county boundary (along the Kinvarra Road) to Quilty including the R479 spur to Doolin
SR15	R474 from Connolly to Milltown Malbay

Map Ref.	View
SR19	Coast road south east of Cappagh to Carrowdotia South
SR20	R473 from outside Labasheeda to T-junction before Kiladysert
SR33	Road running west from Bealaha Bridge as far as its junction with the N67

The CCDP includes Objective CDP13.7 as the development plan objective relating to scenic routes, in which it is stated it is an objective of Clare County Council:

- *"To protect sensitive areas from inappropriate development while providing for development and change that will benefit the rural community;*
- *To ensure that proposed developments take into consideration their effects on views from the public road towards scenic features or areas and are designed and located to minimise their impact;*
- *To ensure that appropriate standards of location, siting, design, finishing and landscaping are achieved."*

Of the five scenic routes within the 20 km LVIA study area, four (SR1, SR19, SR20, SR33) are all coastal routes, designated as scenic due to their location and proximity to the Atlantic coast or Shannon Estuary. The fifth scenic route (SR15 located approximately 6.7 kilometres north of the proposed development site at its nearest point), although inland, it is its view towards the coast that causes this view to warrant listing, rather than the view in the direction of the site. Section 13.6 below dealing with Visual Baseline will address the potential visual impact of the proposed development on these scenic routes.

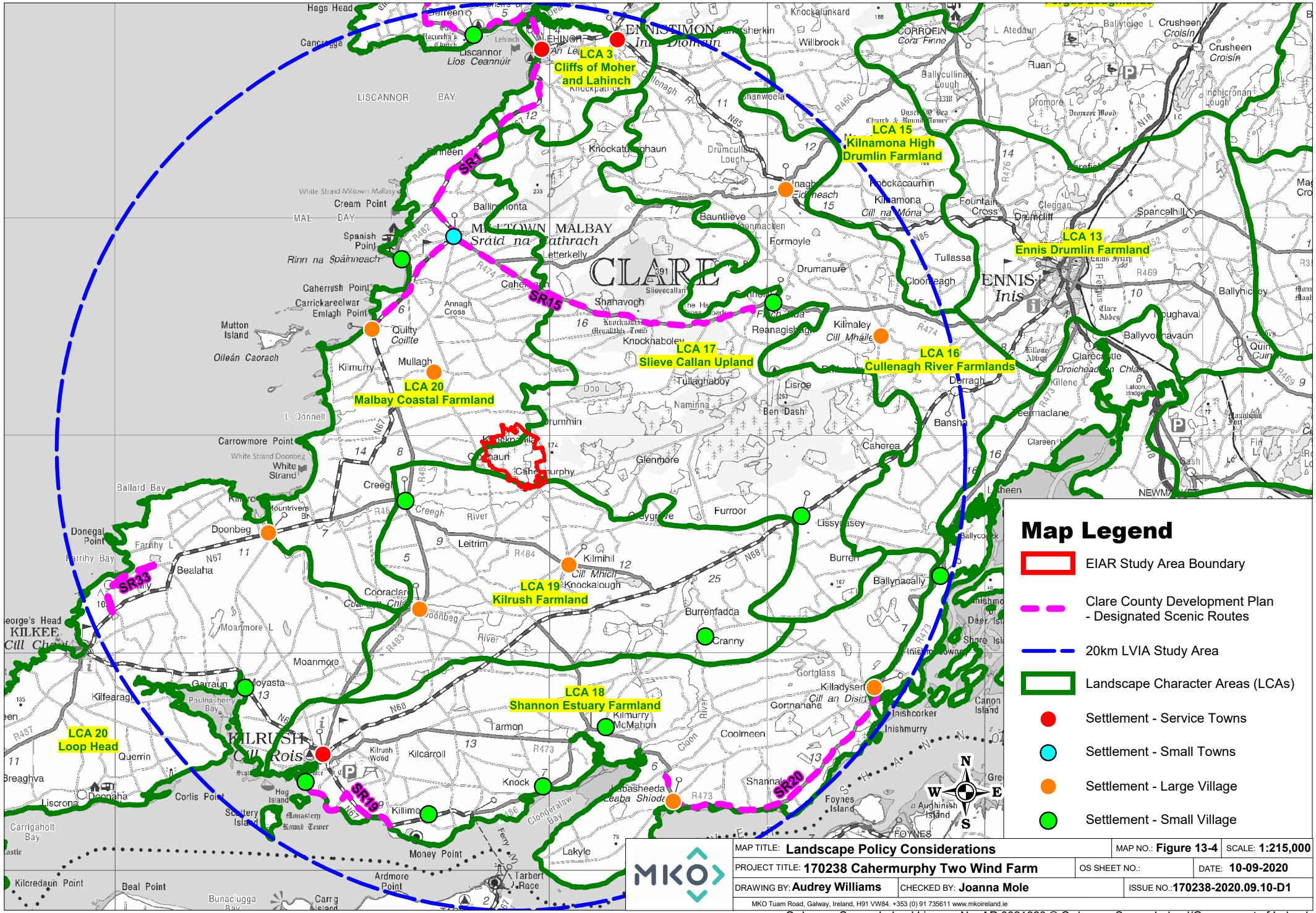
13.4.2.3 Settlements

The CCDP includes in its core strategy, a settlement hierarchy from the County Town of Ennis, down to service towns, small towns, large villages, small villages and cluster settlements as listed in Table 2.1 and Map 3A of the CCDP. The settlements falling within the LVIA study area are outlined in Table 13-6 below and are mapped in Figure 13-4.

Table 13-6 Settlement centres within LVIA 20km study area

Service Towns	Ennistymon/Lahinch; Kilrush
Small Towns	Milltown Malbay
Large Village	Kilmihil; Mullagh; Cooraclare; Quilty; Doonbeg; Kilmaley; Inagh; Killadysert; Labasheeda
Small Villages	Creegh; Connolly; Cranny; Kilmurry McMahon; Knock; Moy; Lissycasey; Ballynacally; Cappagh; Killimer; Liscannor; Spanish Point; Moyasta

Each of these settlement centres will be described and assessed in further detail in Sections 13.6 and 13.7 below.


LCA 3
Cliffs of Moher and Lahinch
LCA 15
Kilnamona High Drumlin Farmland
LCA 13
Ennis Drumlin Farmland
LCA 17
Slieve Callan Upland
LCA 16
Cullenagh River Farmlands
LCA 20
Malbay Coastal Farmland
LCA 19
Kilrush Farmland
LCA 18
Shannon Estuary Farmland
LCA 20
Loop Head
SR1
SR15
SR33
SR19
SR20
CLARE
ENNIS
KILRUSH
KILKEE
MILLTOWN MALBAY
LISCANNOR BAY
MAL BAY
Hags Head
Liscannor
Lios Ceannuir
Cream Point
Spanish Point
Rinn na Spáinneach
Caherrush Point
Carrickareelwar
Emlagh Point
Mutton Island
Oileán Caorach
Carrowmore Point
White Strand
Ballard Bay
Donegal Point
Doonbeg
Bealaha
Moanmore
Kilfearagh
Querrin
Breaghva
Liscrona
Corlis Point
Carrigaholt Bay
Kilcredaun Point
Beal Point
Ardmore Point
Tarbert
Money Point
Clonderalaw Bay
Scattery Island
Hog Island
Kilrush Wood
Kilcarroll
Tarmon
Garraun
Moyasta
Creegh
Creegh River
Doonbeg River
Leitrim
Kilmihil
Cooraclare
Knockalough
Furroor
Lissycasey
Burren
Ballynacally
Burrenfadda
Cranny
Killadysert
Cortnahaha
Gortglass
Inishcorker
Inishmurry
Coolmeen
Kilmurry McMahon
Knockaunkard
Willbrook
Ruan
Knockacaurhin
Kilnamona
Fountain Cross
Cleggan
Drumcliff
Spancelhill
Tullassa
Cloonteagh
Drumanure
Formoyle
Bauntlieve
Shanavogh
Knocknaboley
Kilmaley
Derragh
Bansha
Lisroe
Ben Dash
Tullaghaboy
Naminna
Glenmore
Caherea
Claureen
Ballycullinan Lough
Drumcullaun Lough
Knockatubbrid
Shanweela
Knockalough
Ballyteige
Crusheen
Croisín
Ballyvaughan
Clarecastle
Killeen
Ballyhickey
Shore Island
Canon Island
Foynes Island
Aughinish Island
FOYNES
Lakyle
Shannaha
Labasheeda
Leaba Shíoda
Knock
Killimer
Ferry
Tarbert Race
Bunaclugga Bay
Carrig Island
Mountrivers Br
Farrihy L
Farrihy Bay
Moanmore L
Donoghpatrick
Lehinch
Liscannor Bay
Doo L
L Donnell
Promore L
Inchicronan Lough
Clareabbey
Droichead Chlair
Ennis Friary
Ennis Abbey
Quin
Corofin
Cora Finne
Ballyculinan Lough
Drumcullaun Lough
Church & Round Tower
Monastery
Round Tower
Kilrush Wood
Cill Rois
Cill Mhicil
Cill Mhaile
Cill an Disirt
Leaba Shíoda
Inis
Cill Chais
Cill Chais
Cill Mhicil
Cill Mhaile
Cill an Disirt
Cill na Móna
Droichead Chlair
Leaba Shíoda
Oileán Caorach
Rinn na Spáinneach
Cora Finne
Inis
Cill Rois
Cill Chais
Cill Mhicil
Cill Mhaile
Cill an Disirt
Cill na Móna

13.4.3 Landscape Character Assessment of County Clare

The *Landscape Character Assessment of County Clare* was published in 2004 and outlines the character, value, and sensitivity of landscapes in County Clare. Landscape Types and Landscape Character Areas were then derived from this analysis of the landscape.

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 combinations of geology, landform, soils, vegetation, land use and human settlement, and creates the sense of place found in different areas. The *Landscape Character Assessment of County Clare* identified 21 distinct Landscape Character Areas (LCAs) as shown on Figure 13-5 below.

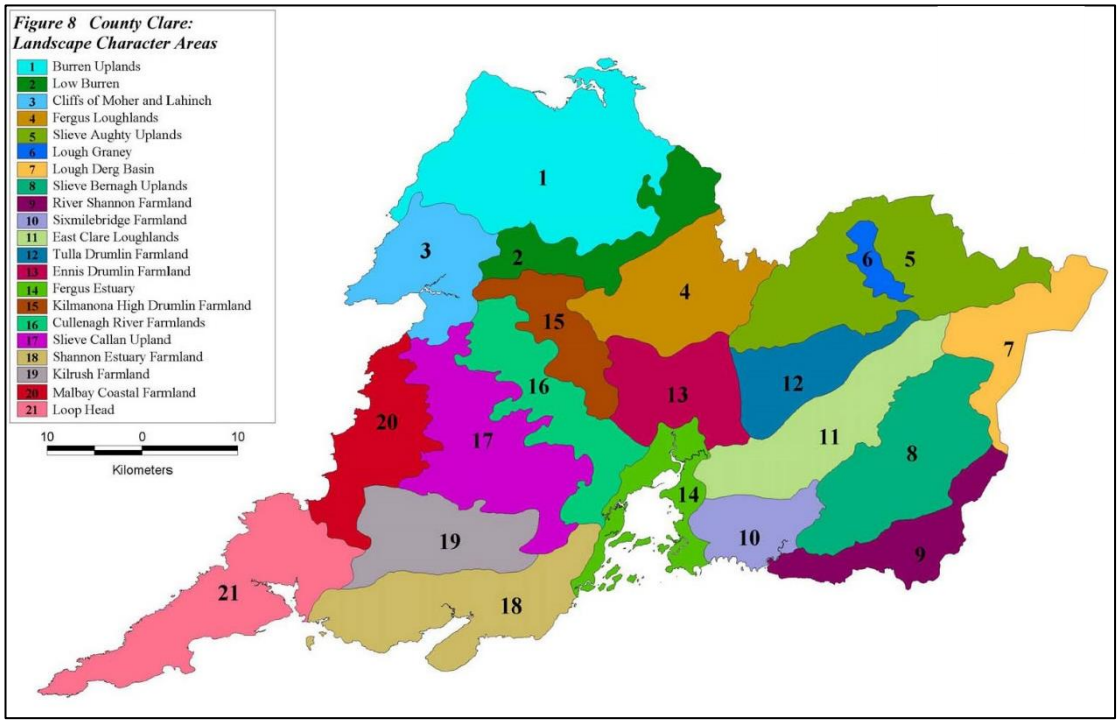


Figure 13-5 Co. Clare Landscape Character Areas (extract from Landscape Character Assessment of Co. Clare (2004))

The site of the proposed development and the location of the ten proposed wind turbines relative to the LCA boundaries have already been mapped in Figure 13-3 above. The locations and extents of all LCAs within the 20-kilometre LVIA study area is shown relative to the site in Figure 13-4.

LCA 17 Slieve Callan Upland

- Key Characteristics
  - Land rises to moorland hills of Sliabh Callan and Ben Dash.
  - Mix of pasture, silage and coniferous habitats.
  - Very little settlement, concentrated along communication routes and in outer parts of the area.
  - Areas become increasingly rural as one travels eastwards, away from the coast.
  - Communications is aligned along valleys.
  - Uplands very exposed, valleys contained but unenclosed. Long views south from Ben Dash towards Shannon Estuary.

LCA 19 Kilmihil Farmlands

- Key Characteristics

- Undulating to rolling hills, medium-high elevation. Some drumlin-type landforms but these do not dominate.
- Complex mix of moorland and farmland.
- Occasional flatter areas within hills, such as Creegh River Valley
- Scattered settlement across the area with Kilmihil, Creegh and Curraclare the only villages.
- Kilmihil town is a designated ACA.

LCA 20 Malbay Coastal Farmland

- Key Characteristics
  - Gently undulating pastoral farmland.
  - Indented coastline, with some wide sandy bays.
  - Strong Atlantic influence through the open and windswept character, reinforced by minimal tree cover and hedgerows.
  - Views to Sliabh Callan, often framed by shallow valleys and along the coastline.
  - Scattered but frequent settlement. Often individual houses but several small villages and larger settlements including Spanish Point and Milltown Malbay.

LCA 3 Cliffs of Moher and Lahinch

- Key Characteristics
  - An area of coastal plateau and farmland gently sloping inwards towards the coast and rivers.
  - Liscannor stone walls with slatey appearance are highly distinctive and widely used throughout the area.
  - Popular tourist centres at Cliffs of Moher, Lahinch and Liscannor.
  - Extensive coastal views are afforded from bays and plateau.
  - Away from the coastal road, it is increasingly remote and an isolated sense is retained.
  - Character of sea strongly affects the area.

LCA 16 Cullenagh River Farmlands

- Key Characteristics
  - Drumlin farmlands drained by Cullenagh river catchment by a series of small loughs.
  - Buckthorn, more deciduous tress and more woody vegetation present with thick hedgerows in parts.
  - Drumlins orientated east-west.
  - Attractive intimate area with rural intact feel.
  - Main settlement at Inagh at crossroads, otherwise scattered.

LCA 18 Shannon Estuary Farmland

- Key Characteristics
  - Prominently ridged landscape, with linear hills aligned south-west to north-east.
  - Secluded areas interspersed with more open views. Views are afforded across the Shannon estuary and across to Limerick from elevated areas and on the estuary shores.
  - Coastal fringe is flatter and slopes down towards the sea.
  - Diverse habitat and land cover.
  - Scattery Island is an important historical and focal feature.
  - Complex patterns of pasture, woodland and scrub habitats.
  - Old Vandeleur Estate plantations, gardens and restored woodland recreation area.

LCA 21 Loop Head Peninsula

- Key Characteristics
  - Flat peninsular farmland – very distinctive ladder fields, estuaries, salt marsh and mudflats, sand and boulder coves, shelving coastal rocks, vertical cliffs.
  - Coast becomes increasingly dramatic towards Loop Head with high cliffs, arches, stacks and rocky inlets. More sheltered bays are typically on the southern side of the peninsula.
  - The presence of the sea is always apparent and the character of the land reflects the mood of the weather and the storminess of the seas.
  - The area is remote and feels remote and detached, with peaceful rural unspoilt qualities.
  - Settlement is more concentrated along the southern peninsula, increasing again towards Kilkee.
  - Kilkee is a designated ACA (Architectural Area).

The Landscape Character Assessment for Co. Clare contains many references to wind farms and the suitability or pressures of wind farms in different areas of the County. These references are no longer considered relevant to the landscape policy context because the Landscape Character Assessment for Co. Clare first published in 2004 was superseded by the Clare Wind Energy Strategy which includes specific consideration of landscape capacity for wind farms of various scales and sizes.

13.4.4 DoEHLG 'Wind Energy Development Guidelines' (2006)

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 are:

- Mountain moorland
- Hilly and flat farmland
- Flat peatland
- Transitional marginal land
- Urban / industrial
- Coast

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.

Landscape character types flat peatland, urban/industrial and coast could be ruled out from the beginning, leaving mountain moorland, hilly and flat farmland and transitional marginal land. Mountain moorland was not applicable as Cahermurphy does not have 'peaked, ridged or rolling mountains', its landcover is not exclusively 'blanket bog, a mottling of heather, wild grasses and some rush.' The landscape of Cahermurphy could not be assigned to 'hilly and flat farmland' as the majority of the land was not 'a patchwork of fields delineated by hedgerows'. However, the key characteristics of 'transitional marginal landscapes' fit and are listed below:

Key characteristics **transitional marginal landscapes:**

- Comprises something of both mountain moorland and farmland, thus involving a mix of small fields, tight hedgerows and shelterbelts;

- May include relatively rugged and rocky terrain, and thus a reasonable degree of spatial enclosure;
- Higher ground tends to be wet and boggy. Lower areas are usually cultivated and managed as fields;
- Houses and farmsteads are usually fairly common; This landscape type bridges the organised and intensively managed farmland and the more naturalistic moorland;

Guidance in relation to location, spatial extent and scale, spacing, layout, height and cumulative effect is provided for each landscape character type in the DoEHLG guidelines. For Transitional Marginal Landscapes, these are detailed below:

Location
As wind energy developments, for reasons of commercial viability, will typically be located on ridges and peaks, a clear visual separation will be achieved from the complexity of lower ground. However, wind energy developments might also be located at lower levels in extensive areas of this landscape type, where they will be perceived against a relatively complex backdrop. In these situations, it is important to minimise visual confusion such as the crossing by blade sets of skylines, buildings, utility lines and varied landcover.

Spacing
All options are possible, depending on the actual landscape characteristics. However, irregular spacing is likely to be most appropriate, given the complexity of landform and land cover typical of these landscapes, and the absence of extensive swaths of fields of regular and rectilinear pattern.

Layout
The likely location of wind energy developments on ridges suggests a linear or staggered linear layout whereas on broader hilltops they could be linear or clustered. Grid layouts are less likely to succeed aesthetically unless there is an open continuity of similar landcover.

Spatial extent
Wind energy developments in these landscapes should be relatively small in terms of spatial extent. It is important that they do not dominate but achieve a balance with their surrounds, especially considering that small fields and houses are prevalent. They should also not bridge two different land covers, e.g. moorland and field areas.

Height
In small-scaled enclosed areas, short turbines are preferred in order to avoid their spatial dominance and to ensure visual balance. However, where the upper ground is relatively open and visually extensive, taller turbines may be more appropriate. In terms of perceived height, the profile can be even or uneven, depending on the profile and visual complexity of the terrain involved. The more rugged and undulating, the greater the acceptability of an uneven profile provided it does not result in significant visual confusion and conflict.

Cumulative effect
This would have to be evaluated on a case-by-case basis, but great caution should be exercised. The spatial enclosure often found in transitional marginal landscapes is likely to preclude the possibility of seeing another wind energy development. However, should two or more wind energy developments be visible within a confined setting a critically adverse effect might result, depending on turbine height and wind energy development extent and proximity.

Although Transitional Marginal Landscapes best describes the site and the LCA in which the site is located, the site and surrounding landscape contains a lot of forestry plantations, which introduces an additional landscape character element to those described in the DoEHLG guidelines.

The site is largely located within LCA 17 'Slieve Callan Uplands', which certainly contains areas of Mountain Moorland, but as this transitions to the coastal plain, the Transitional Marginal Landscapes is a more accurate classification of the site in terms of the DoEHLG guidelines' landscape types.

With reference to the DoEHLG guidelines' references to location, spatial extent and scale, spacing, layout, height and cumulative effect, the following comments are relevant to the site.

In terms of location, the site is located on the western edge of an elevated plateaux of lands, that marks the transition between the West Clare uplands and the Atlantic coastal plain.

In terms of spatial extent, the site and surrounding areas are large in scale as a landscape, while simultaneously being relatively enclosed owing to the local landscape features and topographical undulations in the immediately surrounding areas.

In terms of spacing, the single consolidated site area with limited views towards the site, makes the proposed random (non-linear, non-grid) turbine layout acceptable.

In terms of height, the higher plateaux of land on which the site is located lends itself to the use of taller turbines, particularly given the spatial separation from population centres and scenic routes of significance.

In terms of cumulative effect and acknowledging the other operational wind farms in the wider area, the large scale of the wider landscape is considered to have the capacity to absorb the proposed development.

13.5 Landscape Baseline

13.5.1 Site Location and Landscape Context

The site is located in west County Clare, 26 kilometres west-southwest of the county town of Ennis. The site is on the western edge of an elevated plateaux of land over 100 metres in elevation and extending up to 261 metres (Ben Dash) and 391 metres (Slievecallan) in places that forms an area of upland in central West-Clare. The site is nine kilometres inland from the Atlantic coast, ten kilometres south of the town of Miltown Malbay, 16 kilometres northeast of Kilrush and 12 kilometres east of the village of Doonbeg.

Figure 13-6 Site location

13.5.2 Topography

The elevation of the site ranges from a maximum of 142 metres OD to just less than 80 metres OD. As evident in Figure 13-7 below, a central ridge of higher ground running east-west bisects the site and elevation reduces to the north and south of this ridge.

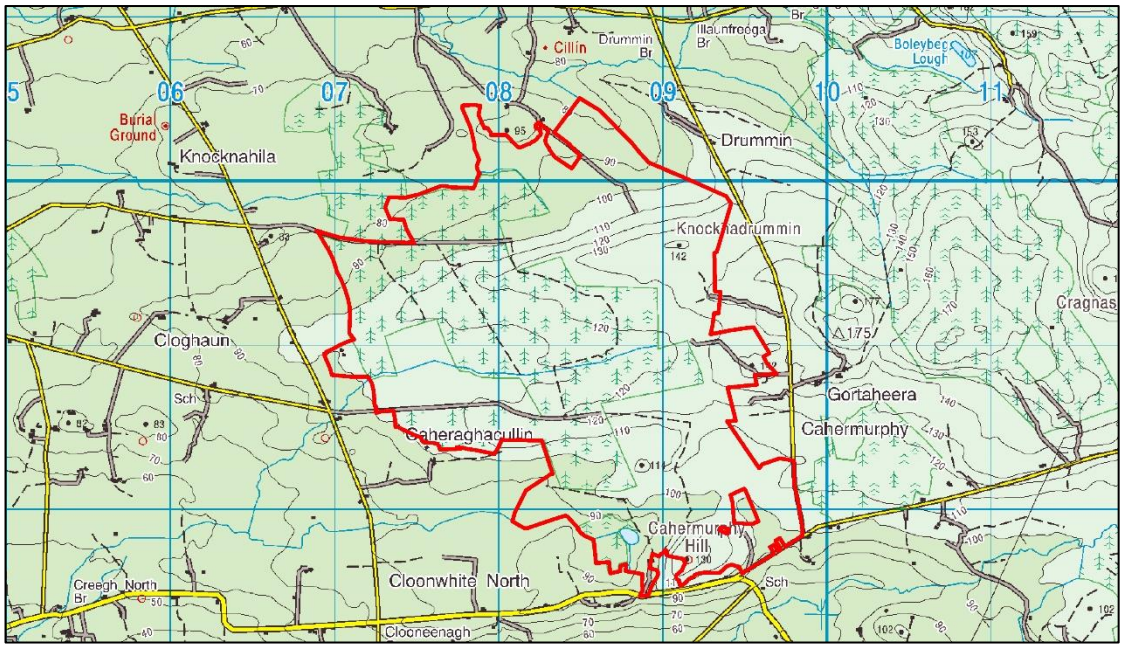


Figure 13-7 Elevation contours within and surrounding the site

The site, and the east-west central ridge is an extension of a much larger area of elevated ground that makes up the central West-Clare uplands including Ben Dash and Slievecallan, as shown in Figure 13-8 below.

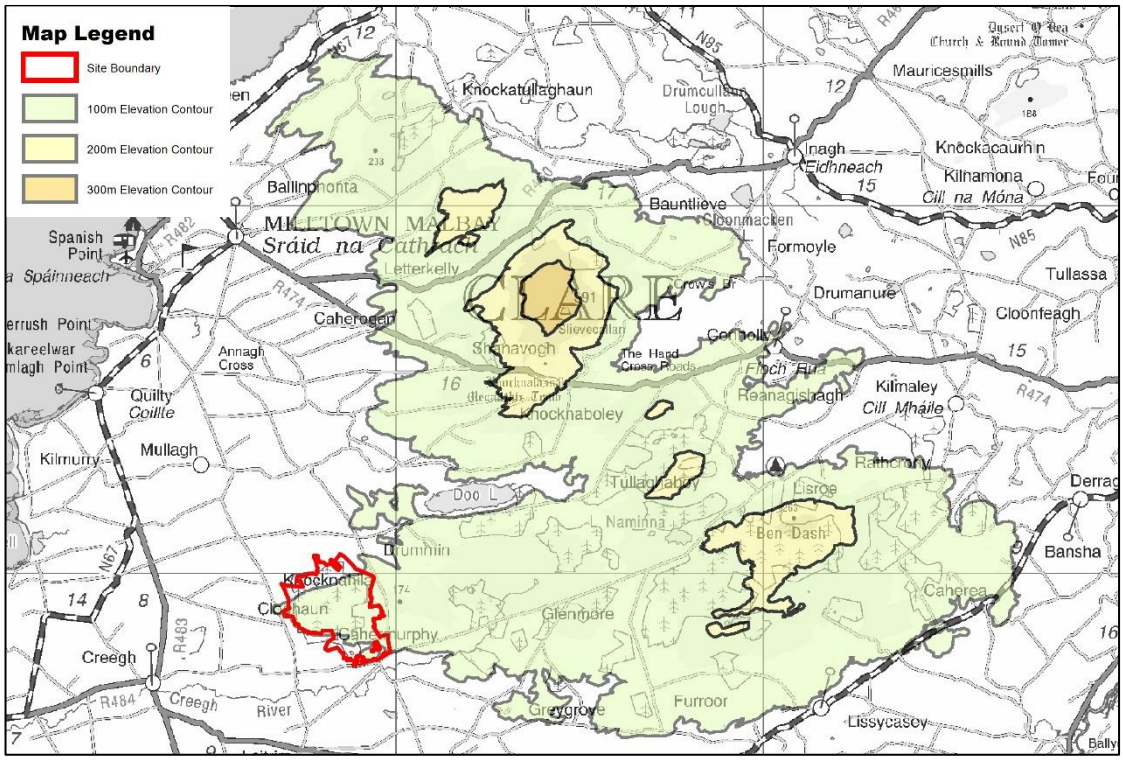


Figure 13-8 100m topographical contours showing west-Clare upland plateaux

13.5.3 Landform

The present-day landscape owes its form to the geological materials from which it was carved. Landform is the spatial and formal arrangement of landscape components as a natural product of geological and geomorphologic processes in the past and refers primarily to topography and drainage.

The geology of County Clare can be conveniently divided into three regions. In the east of the County Silurian sediments deposited in a shallow sea about 440 million years ago [Ma] are surrounded by Devonian sandstones (415 to 360 Ma) laid down when the region was land. Rising sea level in the early Carboniferous, around 360 Ma, drowned the Devonian landmass and deposited a great thickness of limestone, now so clearly exposed across the Burren and beneath the lowlands to the east. Later in the Carboniferous, around 320 Ma, rivers flowing from the south-west built deltas into this shallow sea. As more and more sand and mud was deposited on these deltas, they often became unstable. Sometimes enormous volumes of sediment slumped down into deeper water, breaking and folding the still soft layers as it went. These delta sediments, and some of the spectacular slump folding in them, are superbly exposed in the cliffs of south-west Clare, and form the Upper Carboniferous shales and sandstones that underly the site of the proposed development.

13.5.4 Drainage

The site and wider area generally drains from east to west, from the elevated plateaux of higher ground in the central West-Clare uplands towards the Atlantic coast. The site lies across two sub-catchments of the Annageeragh-Annagh-Creegh-Coastal catchment.

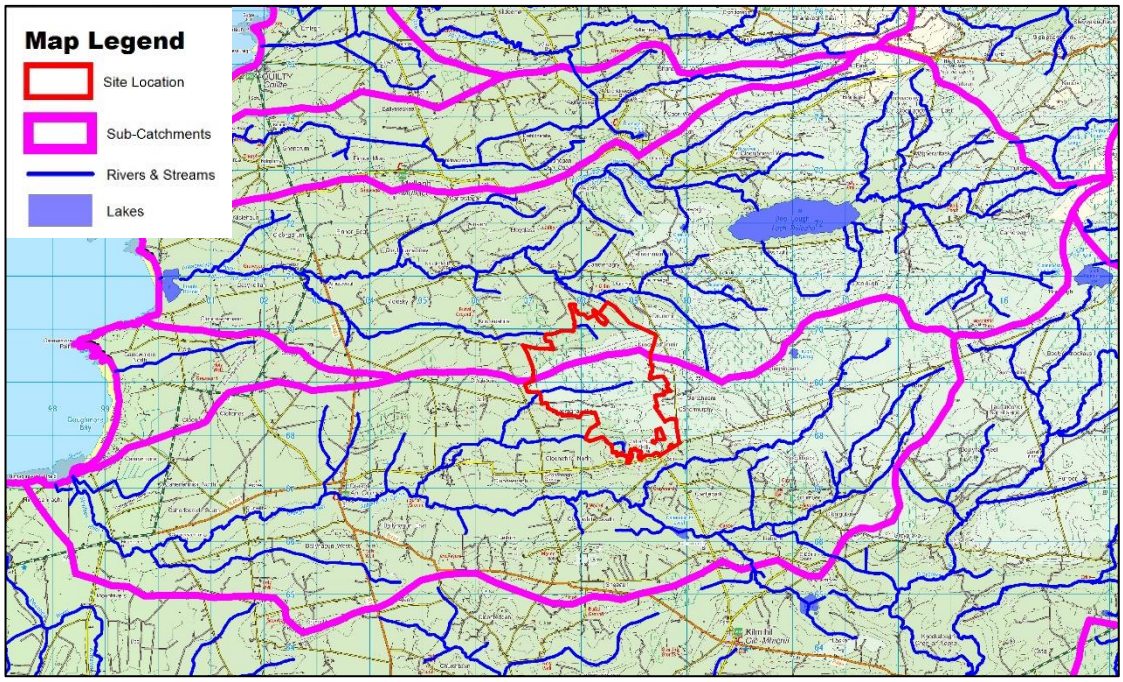


Figure 13-9 Drainage features and river catchments

There are no large waterbodies within the proposed development site. There are a limited number of lakes in the surrounding landscape, such as Doo Lough, Lough Nacreg, Lough Cahermurphy, Creevagh Lough. Lakes are not a prominent feature within the West Clare landscape. Further information on the drainage of the site can be seen in Chapter 10 of this EIAR.

13.5.5 Land Cover and Land Use

The land cover of the site comprises a mix of coniferous forestry, peatland and rough pasture.

The Clare Wind Energy Strategy lists the percentage land cover in the county's *'Strategic'* and *'Acceptable In Principle'* areas. For the Slievecallan strategic area, in which nine of the ten proposed turbines are located, the percentage land cover is listed as follows:

Table 13-7 Percentage land cover (from Corine 2006 data), as per Annex A, Section 6.13 of Clare Wind Energy Strategy

Land Cover Type	% Cover
Transitional woodland	30.0%
Peatland	25.5%
Pasture	18.8%
Land principally occupied by agriculture with significant areas of natural vegetation	12.0%
Conifer forest	10.8%
Others	3.2%

As evident in the aerial photo shown in Figure 13-10 below and the CORINE land cover classification map in Figure 13-11, coniferous forest; peat bogs, land primarily occupied by agriculture and transitional woodland scrub are the dominant land cover and land uses within the site.

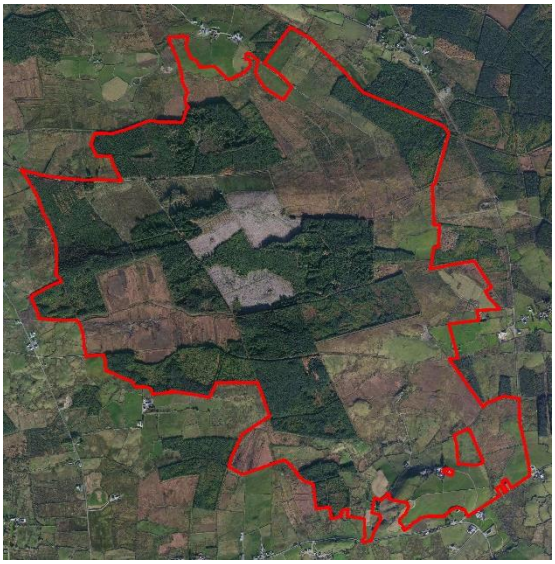


Figure 13-10 Aerial photo of site

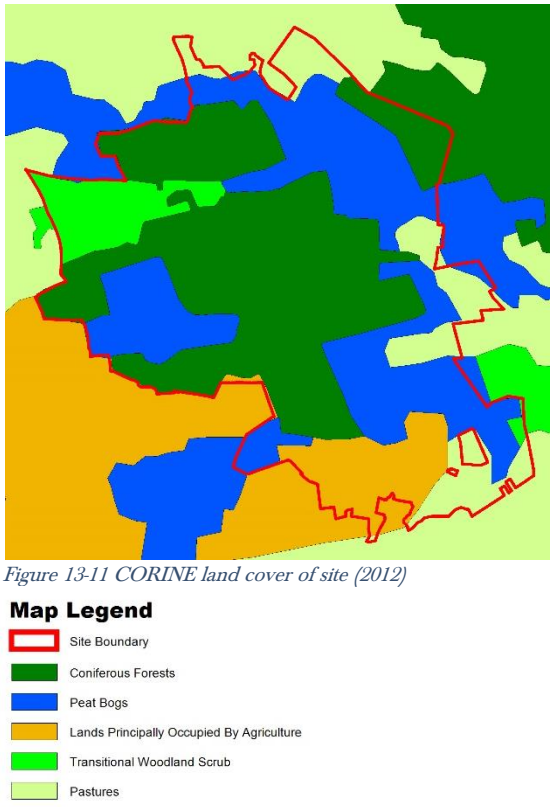


Figure 13-11 CORINE land cover of site (2012)

In the wider landscape, energy and electricity infrastructure is also an increasingly common feature and includes electricity transmission lines and wind farms primarily. These now-established features are indicative of the strong planning policy support for such infrastructure in the west-Clare area.

Plate 13-1 Peat soils and forestry on skyline

Plate 13-2 On-site second-rotation forestry

Plate 13-3 On-site clearfell forestry

Plate 13-4 On-site forestry to pasture transition

Plate 13-5 On-site forestry to peat transition

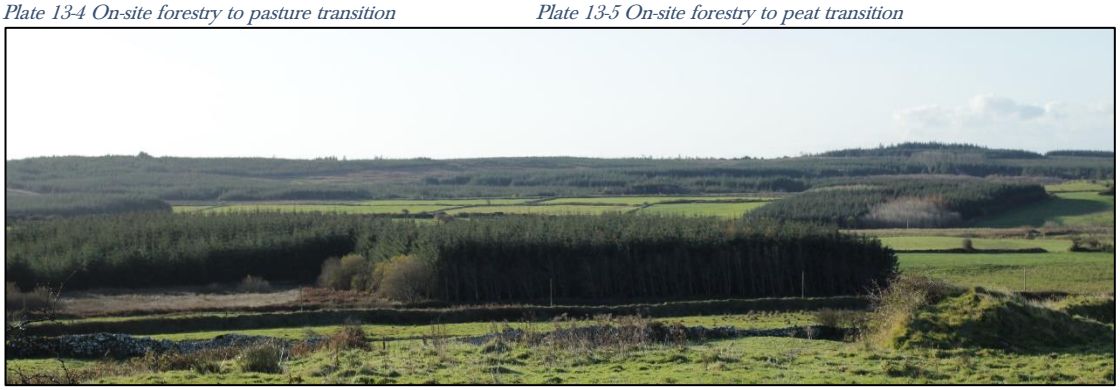


Plate 13-6 Well-established forestry on-site

Plate 13-7 On-site forestry and peat bogs

Plate 13-8 Agricultural pasture and forestry

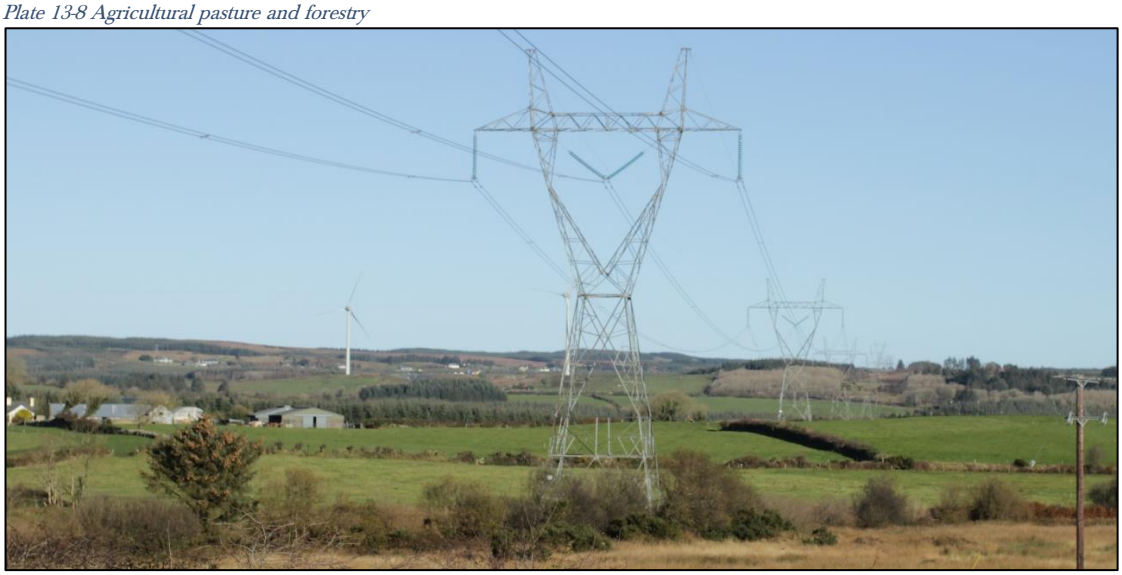


Plate 13-9 Off-site electricity transmission infrastructure

13.5.6 Connectivity

Road access and connectivity to the site and surrounding areas is hierarchical based on the different classes of roads found in the wider LVIA study area. West Clare is primarily accessed by either the N68 National Secondary Route running from Ennis to Kilrush, or the N85 National Secondary Route running from Ennis to Ennistymon and Lahinch. The N67 National Secondary Route is the coastal road linking the coastal towns of Lahinch, Doonbeg and Kilkee. Regional Roads, including the R460, R474 and R484 partially bisect the area encircled by the National Secondary Routes, generally in an east-west

direction. Road connectivity surrounding the site of the proposed development in shown in Figure 13-12.

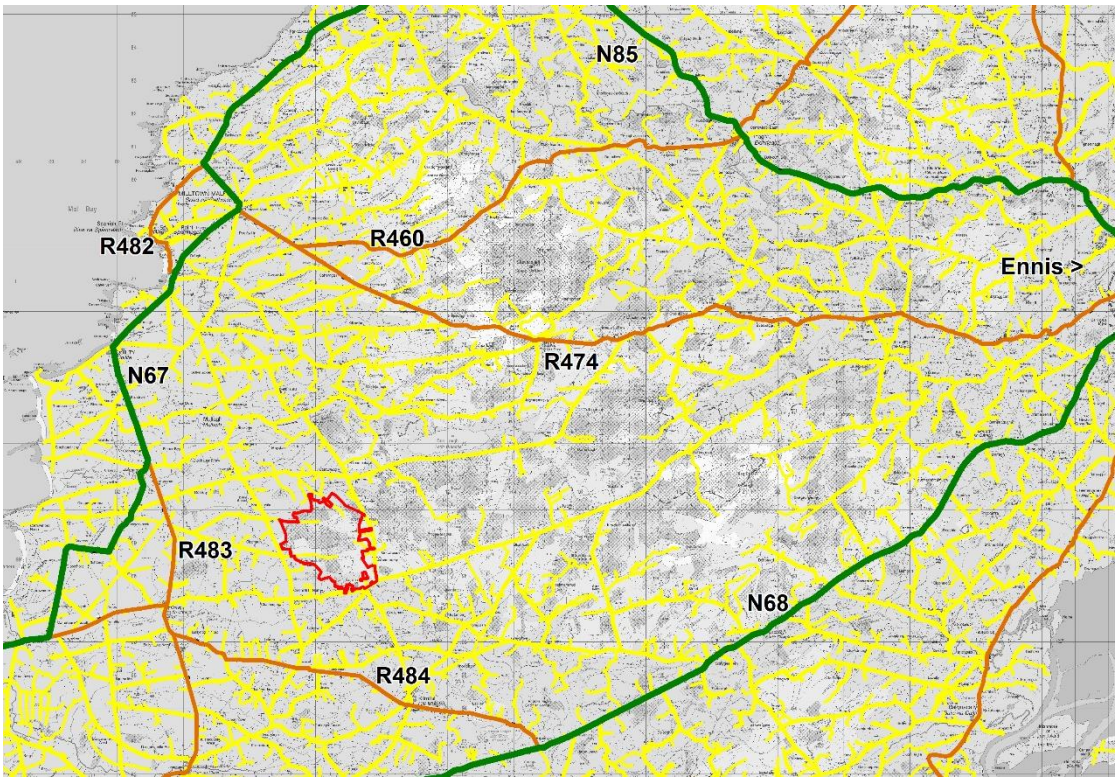


Figure 13-12 Road connectivity

The site of the proposed development is only accessible via a series of local roads. The local road network in West Clare is not heavily trafficked, with the regional and national secondary networks carrying the majority of road traffic. Road users generally use the national and regional networks for the majority of their journeys, departing to use the local road network when necessary. Vertical and horizontal alignments on the local roads can be very variable, and poor in many places, and hence these roads are generally only intended to serve the needs of landowners or homeowners who live or farm along them. Although there is a good network of local roads surrounding the site of the proposed development, it is quite isolated and somewhat difficult to access in terms of connectivity to the better road networks.

13.5.7 Landscape Character

The landscape character of the site and the surrounding areas is derived from the distinct and recognisable pattern of elements that occurs consistently in the landscape. It reflects particular combinations of geology, landform, soils, vegetation, land use and human settlement, to create the particular sense of place.

The site is close to the border of three separate landscape character areas (LCAs) as defined by the Landscape Character Assessment for County Clare but is primarily located in LCA 17 'Slieve Callan Uplands'. The other adjacent LCAs include the LCA 19 'Kilmihil Farmlands' and LCA 20 'Malbay Coastal Farmland'. These LCAs are described further in Section 13.4.3 above.

Within the local area more proximate to the site, there is a more clearly defined physical landscape unit comprising of uplands to the north and coastal features to the west. The topography of this physical landscape unit is undulating, with the highest elevations generally occurring towards the north-east of the site.

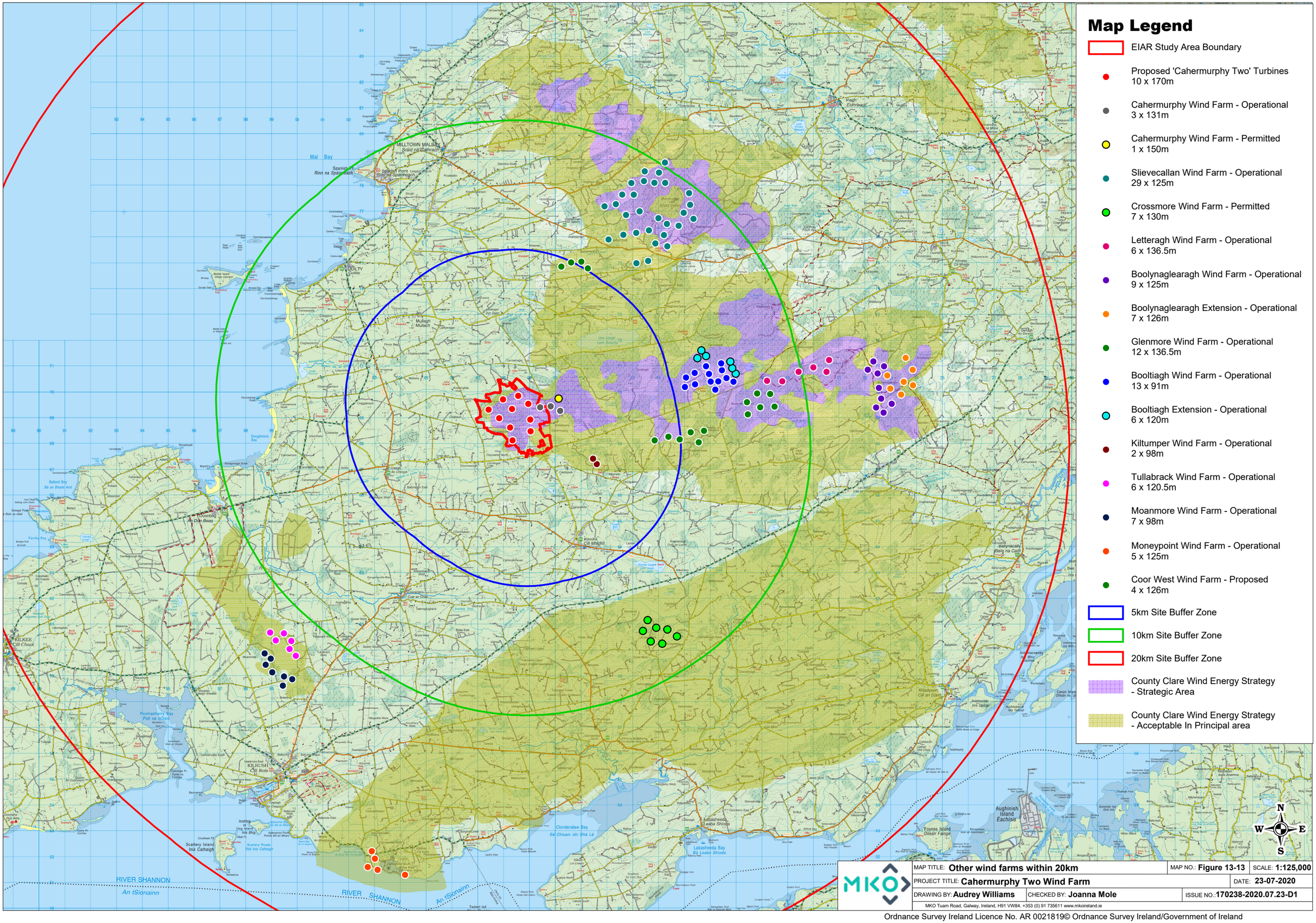
To the west, the lands between the site and the coastline are distinguished from this landscape unit by a considerably higher level of residential development, as well as settlement centres such as in Doonbeg, Lahinch and Kilkee.

13.5.8 Other Windfarms

There are a number of other operational, permitted and under construction wind farms that form part of the baseline landscape in the wider area and are considered in this LVIA. The existing (operational), permitted and other proposed wind farms within 20km of the site can be seen in Figure 13-13 below. The individual details of each wind farm are detailed in the Planning History section of this EIAR, but for the purposes of this LVIA, the key parameters of each wind farm are detailed in Table 13-8 below.

Table 13-8 Other Wind Farms within 20 km of the proposed site

Wind Farm	Status	MW	No. of Turbines	Turbine Tip Heights
Cahermurphy	Operational	6	3	131m
Cahermurphy	Permitted	3	1	150m
Slieve Callan	Operational	71.39	29	125m
Crossmore	Permitted	15	7	125m
Letteragh	Operational	13.4	6	136.5
Boolynagleragh	Operational	36.98	9	125m
Boolynagleragh Extension	Operational		7	126m
Glenmore	Operational	24	12	136.5m
Booltiagh	Operational	19.5	13	91m
Booltiagh Extension	Operational	12	6	120m
Kiltumper	Operational	4.99	2	98m
Tullabrack	Operational	13.8	6	120.5m
Moanmore	Operational	12.5	7	98m
Moneypoint	Operational	15	5	125m
Coor West	Proposed	12	4	126m


MILLTOWN MALBAY
Sráid na Cathrach
Spanish Point
Rinn na Spáinneach
Mal Bay
LISCANNOR
Liscannor
CLAHANE
Clochán
QUILTY
Coillte
Mullagh
Mullach
Doughmore Bay
Ballard Bay
Bá an Bhaird Aird
Doonbeg
An Dún Beag
Kilmihil
Cill Mhichíl
KILKEE
Cill Chaoi
Poulnasherry Bay
Poll na nIasc
KILRUSH
Cill Rois
Scattery Island
Inis Cathaigh
RIVER SHANNON
An tSionainn
Clonderalaw Bay
Bá Chluain Idir Dhá Lá
Kilkerin
Cill Chiaráin
Labasheeda
Leaba Shíoda
Labasheeda Bay
Bá Leaba Shíoda
Foynes Island
Oileán Faoine
Aughinish Island
Eachinis
Inagh
Eidhneach
Ballynacally
Baile na Cailli
Killadysert
Cill an Disirt
Inishcrone
Inis Cearair
Inishtubbrid
Inis Tiobrad
Inishcawrey
Inis Mic Uais
Inishmacowen
Inis Mac Eoghain
Illaunmore
Oileán Mór
Illaunbeg
Oileán Beag
Illaunnaglogh
Oileán na Glóige
Illaunnaglogh
Oileán na Glóige
Illaunnaglogh
Oileán na Glóige

The permitted wind farms are considered to be part of the landscape baseline for LVIA purposes, and will be represented on photomontages and in cumulative ZTV mapping undertaken further below. Any proposed wind farms will also be included on photomontages, ZTV mapping, etc. but will not be considered part of the baseline landscape and environment.

13.5.9 Previous An Bord Pleanála Decisions

Some decisions of An Bord Pleanála on other nearby wind farm proposals are also considered relevant to the landscape baseline.

On Pl. Ref. 14/551 (ABP case reference PL03.245189), in recommending a grant of planning permission for the adjacent four-turbine Cahermurphy project (three turbines of which are currently operational), the An Bord Pleanála inspector noted the following in relation to landscape and visual impact of that proposal:

> "*The detail and appraisal of visual impact provided in the EIS is in my view reasonable. The areas of visibility are extensive and are clearly set out. Having considered the EIS and visited the site and surrounds, I would conclude that having regard to the robust nature of the wider landscape and to the topography and character of the area the proposed Cahermurphy wind turbines will not be an unduly dominant feature in the landscape rather a component in the landscape. I note that the proposed turbines will be a significant feature from the local road which provides access to the site and will alter the character of the local area for a number of residential properties in the local area. However, I consider that given that the proposal represents a reduction from six to four turbines with a less cluttered layout this will lessen the visual impact. Furthermore, I note that there were no third-party objections to the proposal and the fact that the proposed development is promoted by local landowners would appear to significantly influence the local acceptance of the proposal. On the basis of the foregoing I consider that the proposed development can be accommodated in the landscape and will not have a significant detrimental visual impact.*"

On Pl. Ref. 15/860 (ABP case reference PL03.248008), although An Bord Pleanála refused planning permission for this proposed development of 11 turbines further to the east of the current proposed site for reasons not related to landscape or visual impact, the An Bord Pleanála inspector noted the following in relation to landscape and visual impact of that proposal:

> *"Given that the area was adopted as a Strategic Area for wind energy development with potential for 250 MW energy generation and that the predicted cumulative energy generation with the proposed development, at c.194 MW, would not exceed same the capacity of the landscape to accommodate such development may be regarded as not to be exceeded. Therefore, whilst the landscape and visual impact may be significant, this impact may be regarded as acceptable under the policy provisions adopted by the Council having regard to the WEDG"*

13.5.10 Landscape Receptor Preliminary Assessment

After identifying the landscape receptors in the study area based on landscape designations and Landscape Character Areas (LCAs) derived from the Clare County Development Plan, a preliminary assessment was undertaken to screen out landscape receptors that will not be impacted by the proposed development.

Using the Zone of Theoretical Visibility mapping described in Section 13.6.2 below, the landscape receptors within the study LVIA area that will have no theoretical visibility and are screened out for any further assessment are listed below in Table 13-9.

Table 13-9 Landscape receptors screened out – No or only very limited potential visibility determined by ZTV mapping

Table 13-9 Landscape receptors screened out – No or only very limited potential visibility determined by ZTV mapping

Landscape Receptor Category	Landscape Receptor
Landscape Character Areas	LCA 16 'Cullenagh River Farmlands'

Using the same ZTV mapping, the landscape receptors listed below in Table 13-10 will have theoretical visibility of the proposed development and are therefore screened in for further assessment due to their location within the study area and the potential landscape effects they may experience due to the proposed wind energy development.

Table 13-10 Landscape receptors screened in for further assessment

Landscape Receptor Category	Landscape Receptor
Landscape Character Areas	LCA 17 'Slieve Callan Uplands'
	LCA 20 'Malbay Coastal Farmland'
	LCA 19 'Kilmihil Farmlands'
	LCA 18 'Shannon Estuary Farmland'
	LCA 21 'Loop Head Peninsula'

13.6 Visual Baseline

13.6.1 Introduction

The main purpose of establishing the visual baseline is to identify the key visual receptors that should be considered in the visual impact assessment further and the viewpoints to be selected for the production of photomontages to help visualise how the proposed development will appear in the landscape. To this end the following visual receptors have been identified in order of priority and will be detailed in Section 13.6.4 below:

- Designated scenic routes
- Settlements
- Recreational and tourist destinations
- Recreational routes
- 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 13-17.

13.6.2 Zone of Theoretical Visibility (ZTV)

Maps showing the Zone of Theoretical Visibility (ZTV) have been prepared for the proposed development, using the methodology described in Appendix 13.1. The ZTV maps show visibility of the proposed wind farm using the half-blade height of the proposed wind turbines as points of reference.

The area covered by the ZTV maps has a radius of 20 kilometres from the outer-most proposed turbines, excluding any areas of open water off the Clare coast to the west of the site or on the Shannon Estuary to the south of the site. ZTV maps assume a 'bare ground' scenario, i.e. no land-cover, representing visibility of the proposed wind farm in the absence of all natural and manmade features from the landscape, including vegetation, houses and other buildings. In reality, such features will restrict or limit visibility of the wind turbines, due to the screening effects of vegetation, for example forestry and road-side hedgerows and trees, and buildings, particularly within towns and villages.

A total of four ZTV maps have been prepared:

- Figure 13-14 shows the visibility of the proposed wind farm , using the half blade height of the turbine (137.5 metres) as points of reference.
- Figure 13-15 shows the cumulative visibility of the proposed wind farm, along with the other existing, permitted and proposed wind farms in the LVIA study area.
- Figure 13-16 shows the additional comparative cumulative visibility resulting from the proposed development, highlight additional areas where some of the proposed turbines will be visible where no other existing, permitted or proposed wind turbines would otherwise have been visible.
- Figure 13-17 ZTV & Landscape in Appendix 13.2 shows the visibility previously shown in Figure 13-14, but on a 1:50,000 scale base map at page size A0. This map shows the visibility of the proposed development plus all other turbines constructed, permitted and proposed in the vicinity of the site. It also shows the viewpoint locations used for photomontages, scenic routes and landscape character areas and other visual receptors.

Map Legend

- EIAR Study Area Boundary
- 5km Buffer (from outermost turbines)
- 10km Buffer (from outermost turbines)
- 15km Buffer (from outermost turbines)
- 20km Buffer (from outermost turbines)

Turbine visibility

- 1 - 2 Turbines
- 3 - 4 Turbines
- 5 - 7 Turbines
- 8 - 10 Turbines

N
W E
S

MAP TITLE: **Zones of Theoretical Visibility (ZTV) Map**	MAP NO.: **Figure 13-14**	SCALE: **1:150,000**
PROJECT TITLE: **170238 Cahermurphy Two Wind Farm**		DATE: **10-09-2020**
DRAWING BY: **Audrey Williams**	CHECKED BY: **Joanna Mole**	ISSUE NO.:**170238-2020.09.10-D1**

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Map Legend

- EIAR Study Area Boundary
- 5km Buffer (from outermost turbines)
- 10km Buffer (from outermost turbines)
- 15km Buffer (from outermost turbines)
- 20km Buffer (from outermost turbines)
- Cumulative Turbine visibility
  - 1 - 31 Turbines
  - 32 - 63 Turbines
  - 64 - 95 Turbines
  - 96 - 127 Turbines

N
W E
S

MAP TITLE: **Cumulative ZTV Map**	MAP NO.: **Figure 13-15**	SCALE: **1:150,000**
PROJECT TITLE: **170238 Cahermurphy Two Wind Farm**		DATE: **10-09-2020**
DRAWING BY: **Audrey Williams**	CHECKED BY: **Joanna Mole**	ISSUE NO.:**170238-2020.09.10-D1**

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Map Legend

- EIAR Study Area Boundary
- 5km Buffer (from outermost turbines)
- 10km Buffer (from outermost turbines)
- 15km Buffer (from outermost turbines)
- 20km Buffer (from outermost turbines)
- Theoretical Visibility of Existing/Permitted Wind Farms
- Additional Theoretical Visibility of Proposed Development

N
W E
S

MAP TITLE: **Comparative Cumulative ZTV Map**		MAP NO.: **Figure 13-16**	SCALE: **1:150,000**
PROJECT TITLE: **170238 Cahermurphy Two Wind Farm**			DATE: **10-09-2020**
DRAWING BY: **Audrey Williams**	CHECKED BY: **Joanna Mole**		ISSUE NO.**170238-2020.09.10-D1**

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13.6.3 Views Towards Site

Viewpoint locations showing views toward the site were selected at locations where there is some theoretical visibility according to the ZTV maps produced, and at varying distances from the site, varying directions and across all surrounding LCAs . The viewpoint locations were selected as representative locations in the wider landscape, and a basis for assessing the landscape and visual impact of the proposed development.

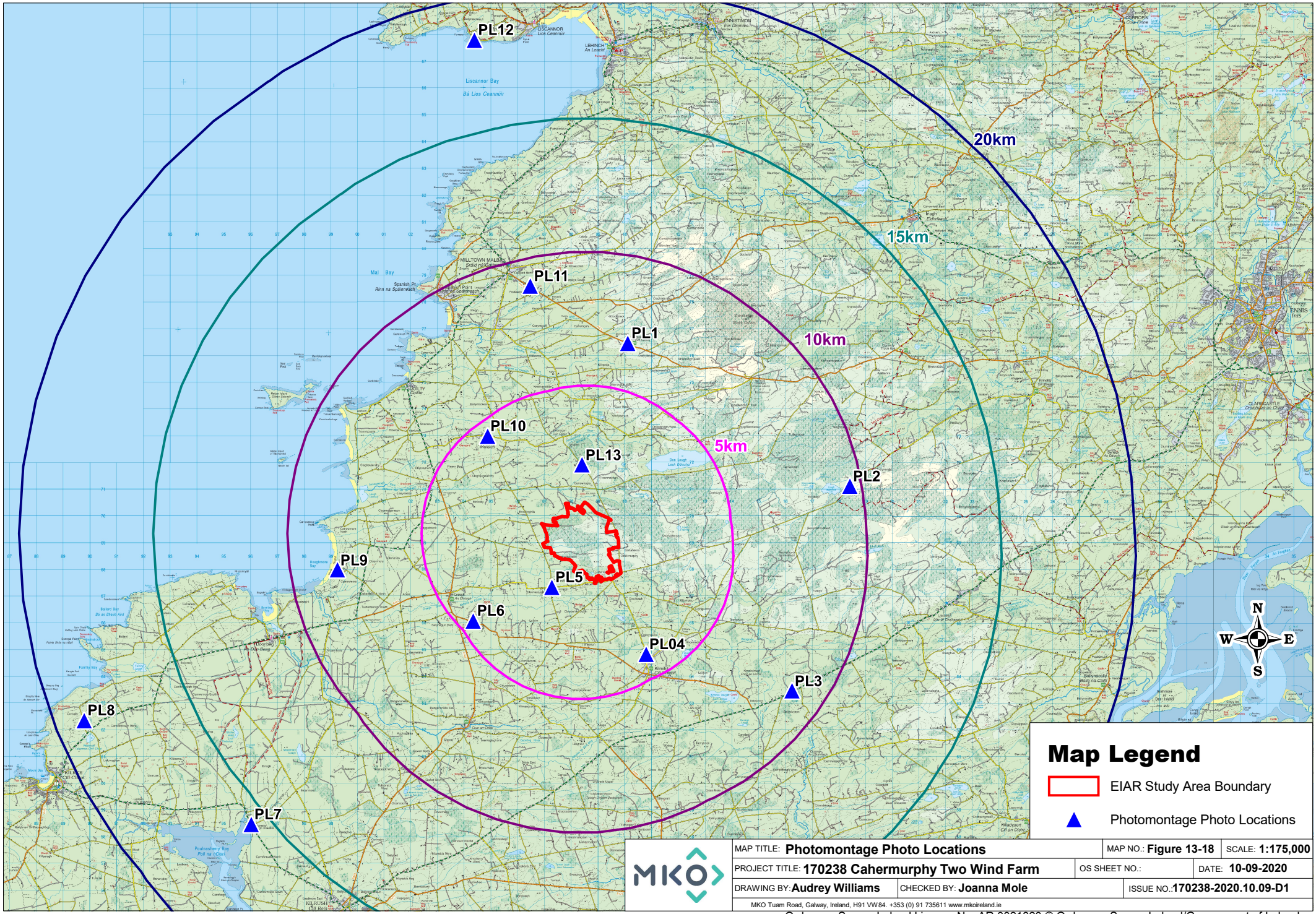
The locations were visited in order to ascertain actual visibility on the ground, and a series of photographs taken to produce photomontages for the final 13 viewpoint locations outlined in Table 13-11 below and shown on Figure 13-18.

The viewpoint locations can be seen in more detail in a panoramic photomontage booklet accompanying this report as Volume 2 of the EIAR.

It is not intended to represent every visual receptor or location with an individual viewpoint and photomontage, nor would that be practical. It is anticipated and expected that readers of this LVIA will use their own personal and/or professional judgement and visit(s) to the study area to judge potential visibility from views for themselves. It is also expected that readers will be able to relate chosen viewpoint locations, distances and directions, to other locations of similar distances from the proposed turbines, and judge likely turbine sizes and visibility accordingly.

Table 13-11 Viewpoints selected for the preparation of photomontages

Viewpoint No.	Description	Distance to Nearest Turbine
1	View from the R474 road, designated Scenic Route No. 15, in the townland of Doonsallagh West, north of the proposed site.	6.63 km
2	View from the townland of Boolyneaska, east of the site from the local road to Kilmaley.	9.53 km
3	View from the N68 National Secondary Route, in the townland of Ballybuneen, southeast of site and 6km southwest of Lissycasey.	8.72 km
4	View from local road, just north of Kilmihil village, south-south-east of proposed site.	4.13 km
5	View from Clooneenagh Cross at junction of two local roads, southwest of proposed site.	1.3 km
6	View from R484, southeast of Creegh village, southwest of proposed site in the townland of Ballynagun East.	4.37 km
7	View from the N67 in the village of Moyasta, southwest of the proposed site.	15.47 km
8	View from a local road, just north of the N67 in the townland of Coorbally, north of Kilkee and west-southwest of the proposed site.	18.81 km



MAP TITLE: **Photomontage Photo Locations**		MAP NO.: **Figure 13-18**	SCALE: **1:175,000**
PROJECT TITLE: **170238 Cahermurphy Two Wind Farm**		OS SHEET NO.:	DATE: **10-09-2020**
DRAWING BY: **Audrey Williams**	CHECKED BY: **Joanna Mole**		ISSUE NO.: **170238-2020.10.09-D1**

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Viewpoint No.	Description	Distance to Nearest Turbine
9	View from a private road off the entrance road to the Doonbeg Golf Resort, in the townland of Carrowmore, west of the proposed site.	7.68 km
10	View from local road east of Mullagh village, northwest of proposed site.	3.66 km
11	View from R474 to the east of Milton Malbay, on designated Scenic Route No. 15, north-north-west of the proposed site.	8.95 km
12	View from Clahane viewpoint, on a local road in the townland of Cloghaundine, west of Liscannor looking southeast towards the proposed site across Liscannor Bay and Lahinch.	18.32 km
13	View from a road in the townland of Carrownagry North, due north of the proposed site.	2.1 km

13.6.4 Visual Receptors

13.6.4.1 Designated Scenic Routes

Table 13-12 below describes the theoretical visibility of the proposed development from the scenic routes that are located within the LVIA study area boundary, as illustrated on the ZTV maps in Figure 13-14 and Figure 13-17.

Table 13-12 Theoretical visibility from scenic routes within LVIA study area

Destination	Description	Theoretical Visibility
5 to 15 km		
SR15	R474 from Connolly to Milltown Malbay	Theoretical visibility limited to western extent of route, with intermittent theoretical visibility as far as The Hand Cross Roads.
5 to 20 km		
SR1	Coast Road from county boundary (along the Kinvarra Road) to Quilty including the R479 spur to Doolin	Theoretical visibility limited to certain sections of N67 from Quilty to Drummin Hill (north of Miltown Malbay) and from area west of Liscannor to 20km LVIA study area extent.
15 to 20 km		

Destination	Description	Theoretical Visibility
SR19	Coast road south east of Cappagh to Carrowdotia South	Extremely limited theoretical visibility, confined to a 500-metre section of road southeast of Kilrush.
SR20	R473 from outside Labasheeda to T-junction before Kiladyser	No visibility.
SR33	Road running west from Bealaha Bridge as far as its junction with the N67	Theoretical visibility along majority of route.

13.6.4.2 Settlements

Table 13-13 below describes the theoretical visibility of the proposed development from the settlement centres that are located within the LVIA study area boundary, as illustrated on the ZTV maps in Figure 13-14 and Figure 13-17.

Table 13-13 Theoretical visibility from settlement centres within LVIA study area

Settlement	Settlement Hierarchy	Theoretical Visibility
Up to 5 km		
Creegh	Small village	Theoretical visibility of 7-10 Turbines
Kilmihil	Large Village	Theoretical visibility of 7-10 Turbines
Mullagh	Large Village	Theoretical visibility of 7-10 Turbines
5 to 10 km		
Cooraclare	Large Village	No visibility
Milltown Malbay	Small Towns	Theoretical visibility of 7-10 Turbines from the town and to the south/southeast, with more limited, intermittent visibility to the north
Quilty	Large Village	No visibility
Spanish Point	Small Village	Theoretical visibility of 7-10 Turbines
10 to 15 km		
Connolly	Small Village	No visibility

Settlement	Settlement Hierarchy	Theoretical Visibility
Cranny	Small Village	No visibility along road through village, but with some limited theoretical visibility of 7-10 Turbines from lands to the north and south of village.
Doonbeg	Large Village	Theoretical visibility of 7-10 Turbines
Kilmurry McMahon	Small Village	No visibility
Kilmaley	Large Village	No visibility
Knock	Small village	No visibility
Moy	Small Village	No visibility
Lissycasey	Small Village	No visibility
15 to 20 km		
Ballynacally	Small Village	No visibility
Cappagh	Small Village	Theoretical visibility of 4-6 Turbines and 7-10 Turbines in different areas.
Ennistymon	Service Town	No visibility
Inagh	Large Village	No visibility
Killadysert	Large Village	No visibility
Killimer	Small Village	No visibility generally, with limited theoretical visibility of 7-10 Turbines to east of village
Kilrush	Service Town	No visibility generally, with limited theoretical visibility to northeast of town
Labasheeda	Large Village	No visibility
Liscannor	Small Village	No visibility
Lahinch	Service Town	No visibility
Moyasta	Small Town	Theoretical visibility of 7-10 Turbines

13.6.4.3 Recreational and Tourist Destinations

Table 13-14 below describes the theoretical visibility of the proposed development from the recreational and tourist destinations that are located within the LVIA study area boundary, as illustrated on the ZTV maps in Figure 13-14 and Figure 13-17.

Table 13-14 Recreational and tourist destinations within LVIA study area (not otherwise captured by reference to settlement centres or scenic routes)

Destination	Description	Theoretical Visibility
5 to 10 km		
Doughmore Bay & White Strand Beach	A 4.5km-long, popular beach located just north of the village of Doonbeg, 9km west of the site of the proposed development.	Theoretical visibility of 7-10 turbines
International Golf Links, Doonbeg	A hotel and golf resort, 9km west of the site of the proposed development.	Theoretical visibility of 7-10 turbines
15 to 20 km		
Lahinch Golf Club	A internationally-renowned, championship golf course, on the northern outskirts of the town of Lahinch, 19km north of the site of the proposed development.	No visibility
Vandeleur Walled Gardens	Walled gardens set among 170 hectares of native woodland, once the garden of the Vandeleur landlords home, Kilrush House. Located 16km southwest of the site of the proposed development.	No visibility
Scattery Island	Scattery Island was the location of a 6th century monastic settlement founded by St Senan, located in the Shannon Estuary south of Kilrush and 20km south of the site of the proposed development.	Theoretical visibility of 7-10 turbines

13.6.4.4 Recreational Routes

Table 13-15 below describes the theoretical visibility of the proposed development from the tourist and recreational routes that are located within the LVIA study area boundary, as illustrated on the ZTV maps in Figure 13-14 and Figure 13-17.

Table 13-15 Recreational routes within LVIA study area

Route Name	Description	Theoretical Visibility
5 to 20 km		
Wild Atlantic Way	Tourist routes	Theoretical visibility of 7-10 turbines on the majority of this route within the study area south of Miltown Malbay. Virtually no visibility further north of Drummin Hill, north of Miltown Malbay.
5 to 10 km		
Mid-Clare Way	Waymarked walking route	Theoretical visibility of 7-10 turbines on approximately 2km on the western edge of this 140km route.
10 to 15 km		
Tullaher Loop, Doonbeg	Waymarked walking route	Theoretical visibility of 7-10 turbines
15 to 20 km		
Kilrush Woodland & Riverside Walk	Waymarked walking route	Theoretical visibility of 4-6 Turbines and 7-10 Turbines in different areas
Cliffs of Moher Coastal Walking Route, Liscannor - Doolin	Waymarked walking route	Theoretical visibility limited to areas west and north of Liscannor at furthest extent of 20km LVIA study area
Burren Way 1 – Lahinch to Doolin	Waymarked walking route	Theoretical visibility limited to areas west and north of Liscannor at furthest extent of 20km LVIA study area
Doolin Cycle Hub	Cycle Route	Theoretical visibility limited to areas west and north of Liscannor at furthest extent of 20km LVIA study area

13.6.4.5 Transport Routes

Table 13-16 below describes the theoretical visibility of the proposed development from the main transport routes and public roads located within the LVIA study area boundary, as illustrated on the ZTV maps in Figure 13-14 and Figure 13-17. For the purpose of selection the most relevant roads, national secondary and regional roads were prioritised.

Table 13-16 Significant transport routes within LVIA study area

Transport Route	Description	Theoretical Visibility
Up to 5 km		
R483/R484	Regional road west and south of site, from N67, through Creegh, Kilmihil to N68.	Theoretical visibility of 7-10 turbines along entire section of road up to 5km from site
N67	National secondary route from Ennistimon south to Killimer, via Miltown Malbay, Doonbeg, Kilkee, Kilrush.	No visibility from road beyond 12km northwest of site. Theoretical visibility of 7-10 turbines on the majority of this route within the study area to the west and south of the site.
5 – 20 km		
R474	Regional road running east-west to north of site, from Ennis to Miltown Malbay	No visibility from road beyond 10km from site, but intermittent theoretical visibility of 7-10 turbines along section of road 5-10km from site
N68	National secondary route from Ennis to Kilrush	No visibility from road beyond 10km east of site. Intermittent theoretical visibility of 7-10 turbines on the majority of the remainder of this route to the south of the site.
15 to 20 km		
N85	National secondary route from Ennis to Ennistimon	No visibility

Transport routes within five kilometres of the site were assessed as part of the route screening analysis and visibility from these routes is discussed separately in Section 13.7.4.4 below.

13.6.5 Visual Receptor Preliminary Assessment

After identifying the visual receptors in the study area based on designated scenic routes, settlements, recreational and tourist destinations, recreational routes 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 ZTV mapping shown in Figure 13-14 and Figure 13-17, the visual receptors that will have no theoretical visibility and therefore will be screened out from any further assessment in this LVIA are listed in Table 13-17 below.

Table 13-17 Visual receptors screened out from further assessment due to ZTV map showing no theoretical visibility

Visual Receptor Category	Visual Receptor with no visibility shown on ZTV
Designated Scenic Routes and Scenic Views	SR19; SR20; SR23

Visual Receptor Category	Visual Receptor with no visibility shown on ZTV
Settlements	Cooraclare; Quilty; Connolly; Kilmaley; Knock; Moy; Lissycasey; Ballynacally; Ennistymon; Inagh; Killadysert; Killimer; Kilmurry McMahon; Labasheeda; Liscannor; Lahinch;
Recreational and Tourist Destinations	Lahinch Golf Club; Vandeleur Walled Gardens;
Transport Routes	N85

Although ZTV mapping indicates some theoretical visibility for scenic routes SR19 and SR33, these routes are on the northern side of the Shannon Estuary, where the intended view of significance is towards the Estuary, and not in the opposite direction towards the site of the proposed development. On this basis, these two additional scenic routes within the study area are not directed towards the proposed turbines and have been screened out from further assessment.

The remaining visual receptors that were not screened out, and therefore screened in to undergo further assessment in this LVIA are listed in Table 13-18 below.

Table 13-18 Visual receptors screened in for further assessment due to ZTV map showing theoretical visibility

Visual Receptor Category	Visual Receptors with theoretical visibility shown on ZTV
Scenic Routes and Scenic Views	SR1; SR15
Settlements	Creegh; Kilmihil; Mullagh; Miltown Malbay; Spanish Point; Cranny; Doonbeg; Cappagh; Kilrush; Moyasta
Recreational and Tourist Destinations	Doughmore Bay & White Strand Beach; International Golf Links, Doonbeg; Scattery Island
Recreational Routes	Wild Atlantic Way; Mid-Clare Way; Tullaher Loop; Kilrush Woodland & Riverside Walk; Cliffs of Moher Coastal Walking Route; Burren Way 1; Doolin Cycle Hub
Transport Routes	R483/R484; N67; R474; N68

Following the preliminary assessment exercise, the visual receptors that remained screened in for further assessment influenced the selection of viewpoint locations for photomontage preparation.

Table 13-19 below lists the viewpoints that were selected to attempt to represent the views from the key visual receptors that have been screened in for further assessment.

Table 13-19 Viewpoints selected to represent visual receptors screened in for assessment

Visual Receptor Category	Visual Receptor	Viewpoint
Designated Scenic Routes and Scenic Views	SR1	12
	SR15	1; 11
Settlements	Creegh	6
	Mullagh	10
	Milltown Malbay; Spanish Point	11
	Kilmihil	4
	Doonbeg	9
	Moyasta	7
Recreational and Tourist Destinations	Doughmore Bay & White Strand Beach; Doonbeg International Golf Links,	9
Recreational Routes	Wild Atlantic Way	7; 8; 9; 11; 12
	Cliffs of Moher Coastal Walking Route; Burren Way; Doolin Cycle Hub	12
	Mid-Clare Way	2
Transport Routes	R483/484	4, 6
	N67	7; 8; 9
	R474	1; 11
	N68	3

13.7 Likely or Significant Landscape and Visual Effects

13.7.1 Introduction

This sub-section assesses the likely and significant effects under a variety of headings. As per the EPA guidance, effects (or impacts as they are referred to in the guidance) are classified with reference to Quality, Duration and Type in accordance with the EPA classification terminology outlined in Chapter 1 of this EIAR.

With reference to visual effects of wind turbines, the quality of the effect is somewhat subjective as acknowledged by the DoEHLG (2006) Guidance – and the quality of the effect will not necessarily appear the same to different viewers. However, non-turbine effects are assessed in terms of their quality, whether positive, negative or neutral.

The likely significant effects are discussed below in terms of Significance, Duration, and where necessary, are distinguished by Type. Where mitigation measures are proposed, a residual effect is then included.

By their nature, wind farm developments and associated works generally give rise to direct rather than indirect effects, and therefore all effects are direct unless otherwise stated.

As recognised by the DoEHLG's 2006 Guidelines, while many issues in relation to wind energy development can be assessed in quantitative terms, aesthetic or visual considerations are more subjective and qualitative. Also recognised by the Guidelines for Landscape and Visual Impact Assessment (GLVIA) (The Landscape Institute/Institute of Environmental Management and Assessment, UK, 2013) is the fact that determining the significance of effects is an evidence-based process combined with professional judgement. The basis for any such judgement is clearly set out in the below or relevant appendices in a transparent and understandable format, so that the underlying assumptions and reasoning can be understood by all readers.

This assessment of landscape and visual effects considers all elements of the proposed wind farm development but is concentrated on the proposed wind turbines due to their scale and potential visibility being significantly greater than any other element of the proposed development.

13.7.2 'Do-Nothing' Scenario

In the Do-Nothing scenario, the proposed development would not take place. The opportunity to harvest the wind resource at the site would be lost. Existing land uses would continue, which are forestry operations, including felling and replanting, agriculture and turbary. The existing wind farm developments in the general vicinity would continue to operate for their full permitted lives, including the adjacent four-turbine Cahermurphy wind farm, three of which are already operating. Other planning applications for wind farm developments are likely to continue to be brought forward for consideration in the wider area in years to come to meet the State's objective to decarbonise the economy and combat climate change, and until the stated acceptable capacities of the Clare Wind Energy Strategy's 'Strategic', 'Acceptable In Principle' and 'Open to Consideration' areas are delivered in full.

13.7.3 Landscape Effects

13.7.3.1 Landscape Character of the Proposed Development Site

The character of the proposed development site will change due to not just the turbines, but also individual elements ancillary to the proposed wind turbines as well as felling required to accommodate this.

13.7.3.2 Landscape Character Areas

An assessment of the effects on landscape character was undertaken for the six LCAs within the LVIA study area that were identified as having theoretical visibility of the proposed development in the Landscape Receptor Preliminary Assessment above and listed in Tabel 13-10 of the same section. The individual assessments for each LCA are presented in Appendix 13.3 and are summarised in Table 13-20 below.

Table 13-20 Landscape Character Summary Assessment

Landscape Character Area (LCA)	LCA Sensitivity to Wind Farm Development	Magnitude of Change	Significance of Landscape Character Effect (EPA, 2017)
LCA 17 Slieve Callan Uplands	Low - Medium	Moderate	Slight
LCA 19 Kilmihil Farmland	Medium	Slight	Slight
LCA 20 Malbay Coastal Farmland	High	Slight	Moderate
LCA 3 Cliffs of Moher and Lahinch	High	Negligible	Not Significant
LCA 18 Shannon Estuary Farmland	Medium	Slight	Minor
LCA 21 Loop Head Peninsula	Medium	Slight	Slight

LCA 17 and LCA 19 are clearly intended to accommodate the majority of the wind farm development envisioned in the Clare Wind Energy Strategy as large parts of these LCAs are designated as Strategic Areas for Wind Farm development. The lower sensitivity of these LCAs to wind farm development result in Slight effects to landscape character.

Given the distance from the site of the proposed development to LCAs 3, 18 and 21, the magnitude of change of very low, resulted in Not Significant, Minor and Slight effects to landscape character in these three LCAs respectively.

The two of the ten proposed turbines located within the boundary of LCA 20 are also located in an area classified as a “Strategic Area” for wind farm development in the Clare Wind Energy Strategy. Although only two proposed turbines are actually located within LCA 20, the “high" sensitivity of this LCA to wind farm development gives rise to a Moderate effect to the LCA’s landscape character, although the development is primarily located in an LCA of lower sensitivity.

13.7.3.3 Cumulative Landscape Effects

After identifying the cumulative baseline and cumulative status for each LCA, as assessment was made as to whether the additional proposed turbines would change the status of the individual LCAs. Although, it was found that the proposed development's turbines would add to the cumulative landscape status, they would not change the character of the individual LCAs in terms of wind energy and therefore the cumulative landscape effects are considered **Slight.** Wind turbines are already a common component of the west Clare landscape, as identified and intended by the Clare Wind Energy Strategy.

The scale of the cumulative effect is also considered to be well within what was envisaged and considered to be acceptable under Clare Wind Energy Strategy which would have been subject to a full Strategic Environmental Assessment (SEA). The proposed development does not transform or redefine the baseline landscape character from any but a small handful of selected viewpoints.

13.7.4 Visual Effects

13.7.4.1 Viewpoints Assessment

An assessment of the visual effects of the proposed turbines was undertaken from the 13 viewpoint locations identified in Section 13.6.3 above using the assessment methodology described in Appendix 13.1. The locations of these viewpoints are shown in Figure 13-18, above. The individual assessments from the 13 viewpoints are presented in Appendix 13.4 and summarised in Table 13-21 below. Appendix 13.4 and Table 13-21 should be read in conjunction with the photomontage booklet forming Volume 2 of the EIAR.

The visual effect of the proposed wind farm 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.

Table 13-21 Viewpoint assessment summary

No.	Description	Distance to nearest turbine	Landscape Character Area & LCA Sensitivity at viewpoint	Sensitivity of Visual Receptor(s) (at viewpoint)	Magnitude of Change	Residual Significance of Visual Effects
1	View from the R474 road, designated Scenic Route No. 15, in the townland of Doonsallagh West, north of the proposed site.	6.63 km	LCA 17 Slieve Callan Uplands – Medium to Low (CWES)	Medium	Slight	**Slight (EPA, 2017)**
2	View from the townland of Boolyneaska, east of the site from the local road to Kilmaley.	9.53 km	LCA 17 Slieve Callan Uplands - Medium to Low (CWES)	Low	Slight	**Not significant (EPA, 2017)**
3	View from the N68 National Secondary Route, in the townland of Ballybuneen, southeast of site and 6km southwest of Lissycasey.	8.72 km	LCA 19 Kilmihil Farmland – Medium (CWES)	Medium	Slight	**Slight (EPA, 2017)**
4	View from local road, just north of Kilmihil village, south-south-east of proposed site.	4.13 km	LCA 19 Kilmihil Farmland – Medium (CWES)	Medium	Moderate	**Moderate (EPA, 2017)**
5	View from Clooneenagh Cross at junction of two local roads, southwest of proposed site.	1.30 km	LCA 19 Kilmihil Farmland – Medium (CWES)	Medium	Substantial	**Moderate (EPA, 2017)**
6	View from R484, southeast of Creegh village, southwest of proposed site in the townland of Ballynagun East.	4.37 km	LCA 19 Kilmihil Farmland – Medium (CWES)	Medium	Moderate	**Moderate (EPA, 2017)**

No.	Description	Distance to nearest turbine	Landscape Character Area & LCA Sensitivity at viewpoint	Sensitivity of Visual Receptor(s) (at viewpoint)	Magnitude of Change	Residual Significance of Visual Effects
7	View from the N67 in the village of Moyasta, southwest of the proposed site.	15.47 km	LCA 21 Loop Head Peninsula – Medium (CWES)	Medium	Slight	**Not significant (EPA, 2017)**
8	View from a local road, just north of the N67 in the townland of Coorbally, north of Kilkee and west-southwest of the proposed site.	18.81 km	LCA 21 Loop Head Peninsula – Medium (CWES)	Medium	Negligible	**Not significant (EPA, 2017)**
9	View from a private road off the entrance road to the Doonbeg Golf Resort, in the townland of Carrowmore, west of the proposed site.	7.68 km	LCA 20 Malbay Coastal Farmland - High (CWES)	High	Slight	**Slight (EPA, 2017)**
10	View from local road east of Mullagh village, northwest of proposed site.	3.66 km	LCA 20 Malbay Coastal Farmland - High (CWES)	Medium	Moderate	**Moderate (EPA, 2017)**
11	View from R474 to the east of Milton Malbay, on designated Scenic Route No. 15, north-north-west of the proposed site.	8.95 km	LCA 20 Malbay Coastal Farmland - High (CWES)	Medium	Moderate	**Slight (EPA, 2017)**
12	View from Clahane viewpoint, on a local road in the townland of Cloghaundine, west of Liscannor looking southeast towards the proposed site across Liscannor Bay and Lahinch.	18.32 km	LCA 3 Cliffs of Moher and Lahinch - High (CWES)	High	Negligible	**Imperceptible (EPA, 2017)**
13	View from a road in the townland of Carrownagry North, due north of the proposed site.	2.10 km	LCA 20 Malbay Coastal Farmland - High (CWES)	Medium	Substantial	**Moderate (EPA, 2017)**

Visualisations such as photomontages are visual aids that can represent the likely effect of a development and are used to inform the reader's understanding 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, and therefore, no assessment of whether an effect is positive or negative is provided. The predicted visual effect of all the viewpoints below are Long Term and Direct effects.

The assessment of visual effects in Table 13-21 determined theresidual significance of the visual effects to range from 'imperceptible' to 'moderate', with the number at findings at each level of significance listed in Tabel 13-22 below.

Table 13-22 Viewpoint Summary

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	5
Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities	4
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.	3
Imperceptible	An effect capable of measurement but without significant consequences	1

The significance of the residual visual effect was not considered to be "Profound", "Very Significant" or "Significant" at any of the 13 viewpoint locations. All other viewpoints were assessed as resulting in Moderate (5), Slight (4), Not Significant (3) or Imperceptible (1) residual visual effects.

The viewpoint assessment results will be discussed further in the following sections in the assessment of other landscape features.

13.7.4.2 Scenic Routes

The Scenic Routes listed within the Clare County Development Plan 2017-2023 and identified as being relevant to this LVIA in Table 13-18 above, were also assessed to determine the potential effect the proposed development may have thereon. Where any effects arise, they are deemed to be neutral in quality (because of the subjective opinions of different observers towards wind turbines in the

landscape), long-term, residual effects, with a significance outlined in Table 13-23 below for the reasons given.

Table 13-23 Significance of effects on scenic routes and scenic views

Map Ref.	Description of visual effects	Significance of effect
SR1	This scenic route is over 75km in length, with less than 30km falling within the LVIA study area. The dominant and intended view along the route is towards the coast and the Atlantic Ocean, rather than in an eastern direction towards the proposed wind farm. There will be intermittent visibility of the proposed turbines for approx. 8km north of Quilty at a range of 8-12km from the nearest proposed turbine. Wind turbines are already visible from this scenic route, but the proposed development will bring those that will be visible slightly closer, albeit still 8-12km from the route.	**Slight (EPA, 2017)** An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
SR15	There will be intermittent visibility of the proposed development from the western-most 5km of this scenic route, closest to Miltown Malbay. There is no theoretical visibility for the remaining 11.5km of this scenic route extending from Inagh to the west. By the time the proposed turbines come into view for motorists on the R460 travelling west towards Miltown Malbay, the view towards the Atlantic Ocean and the coastline is the dominant view and is most likely the intended view for which this route is designated as scenic. Any turbines visible will be viewed at a distance of more than 8 km, and so will not be prominent or dominant from the view. The will also only be visible at an oblique angle from the general direction of the scenic route where the road runs east-west and the wind farm site is located to the south.	**Not Significant (EPA, 2017)** An effect which causes noticeable changes in the character of the environment but without significant consequences.

Viewpoint 1, 11 and 12 have been taken on these scenic routes and represent the visual impact expected when travelling these roadways. However, none of the scenic routes' intended views, as aforementioned, are in the direction of the proposed wind farm, therefore minimising the visual impact on the scenic routes.

13.7.4.3 Visual effects in the LVIA study area

When comparing the ZTV mapping's theoretical visibility referred to in Section 13.6.2 above with what is seen on the ground during site visits and what is visible in the photomontages in Volume 2 of this EIAR, it is clear that the visibility of the proposed development can be impeded by both landform and landcover features. The site of the proposed development is on the western edge of an elevated plateaux of land over 100 metres in elevation and extending up to 261 metres (Ben Dash) and 391 metres (Slievecallan) and the elevated ridgeline that runs between two prominent peaks reduces the potential for any visibility from a number of directions and locations to the east of the site. There is more theoretical visibility in the immediate vicinity of the site and from the west as the topography falls towards the coast resulting in a more undulating pattern in the landscape.

The visual effects in the LVIA study area are strongly guided by the 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 mapping shows theoretical visibility being greatest to the immediate west and southwest of the site, as the land gently lowers towards the coast providing less screening from topography. There is more intermittent visibility in the south and southeast. Visibility to the west is confined to the elevated ridges between Slievecallan and Ben Dash, with no visibility beyond to the northeast.

Any areas within a five kilometre radius of the site showing theoretical visibility were selected for Route Screening Analysis which will be discussed in the section below. Route screening analysis is a means of presenting a more accurate assessment of the actual visibility of the proposed development as opposed to the theoretical ZTV mapping by taking into account the effect that screening such as buildings, hedgerows, trees, small rises in topography etc.

13.7.4.4 Route Screening Analysis

In order to comprehensively assess actual visibility in comparison to the theoretical visibility, Route Screening Analysis was undertaken on all roads within a five-kilometre radius of the site of the proposed development. The full methodology is outlined in Appendix 13.1 but every road section subject to the route screening analysis was categorised as one of the following:

- Little/no screening – mainly open and with some very light vegetation
- Intermittent/Partial Screening – light deciduous roadside vegetation and vegetation with short gaps which would allow intermittent or partial views
- Dense Screening – vegetation which is dense enough to block views (e.g. coniferous forestry)

Figure 13-19 below outlines the Route Screening within a five-kilometre radius of the proposed development site.

Plate 13-10 Example of "Little/No Screening" from Route Screening Analysis

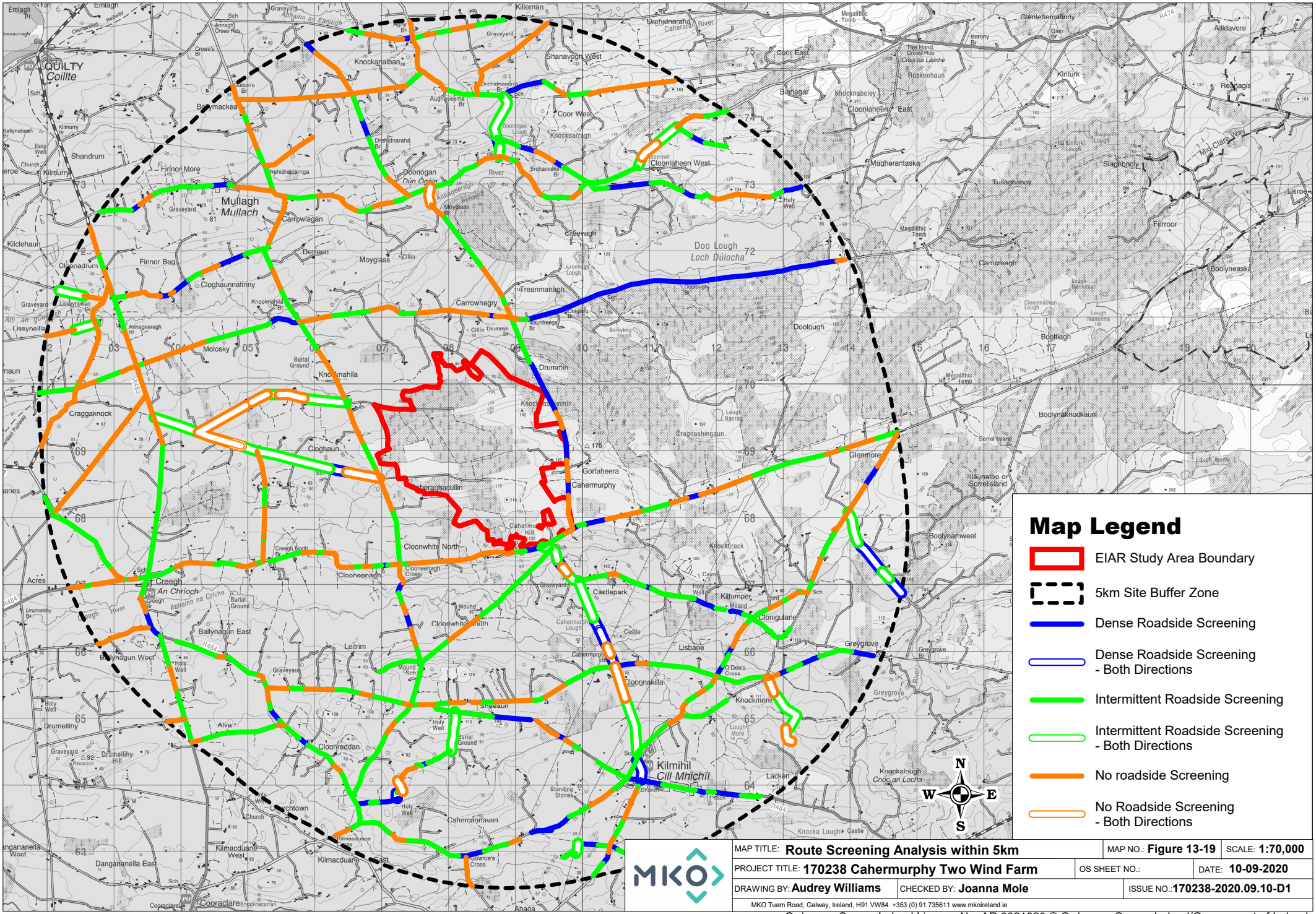

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Plate 13-11 Example of "Intermittent/Partial Screening" from Route Screening Analysis

Plate 13-12 Example of "Dense Screening" from Route Screening Analysis

A total of 148.73 kilometres of roadway was assessed and classified in the Route Screening Analysis as outlined in Table 13-24 below. Of this total length of road, views in the direction of the proposed development will be entirely screened by dense roadside screening along 15% of the roads and will be intermittently screened over a further 46% of the five-kilometre route screening analysis study area. Little or no screening exists across 39% of the roadways, where the theoretical visibility displayed in the ZTV mapping is more likely to accurately represent the actual views of the proposed development.

Table 13-24 Route screening analysis of roads within 5km of site

Road Screening Category	Length of Road	% of Total
Little/No Screening	57.9 km	39%
Intermittent Screening	67.82 km	46%
Dense Screening	23.01 km	15%
Total:	**148.73 km**	**100%**

13.7.4.5 Settlements

Of the 26 settlements identified in the study area, 16 were screened out in the 'Visual Receptor Preliminary Assessment', as no visibility of the proposed development could be established from the ZTV analysis. Seven of the ten remaining settlements were represented by chosen viewpoint locations, that have been previously described and the visual effects from each assessed. Viewpoints were selected for the three closest remaining settlements that were screened in, Creegh (VP6), Mullagh (VP10) and Kilmihil (VP4), each being located within five kilometres of the proposed site. In the 5-10 kilometre range of distance from the site, a single viewpoint (VP11) can represent the view from Miltown Malbay and Spanish Point. Beyond 10 kilometres, Doonbeg is represented by VP9.

From the village of Kilmihil, there is full theoretical visibility according to the ZTV maps but the route screening analysis shows the village itself is densely or intermittently screened as is evident on Plate 13-13 below. The classification of the visual effect of VP6 as "Moderate" would not be accurate for the view from the village of Kilmihil itself for which a reduced classification of significance of Not Significant is considered more appropriate.

Plate 13-13 View looking east from the village of Kilmihil, where the site of the proposed development is to the left (northeast)

From the village of Mullagh, there is full theoretical visibility according to the ZTV maps but the route screening analysis shows the village itself is densely or intermittently screened as is evident on Plate 13-13 below. The classification of the visual effect of VP10 as "Moderate" would not be accurate for the view from the village of Mullagh itself for which a reduced classification of significance of 'Not Significant' is considered more appropriate.

Plate 13-14 View looking east from the village of Mullagh, where the site of the proposed development is to the right (southeast)

Plate 13-15 View looking east from the village of Creegh, where the site of the proposed development is straight ahead (east)
From the village of Creegh, there is full theoretical visibility according to the ZTV maps but the route screening analysis shows the village itself intermittently screened as is evident on

Plate 13-15 above. The classification of the visual effect of VP6 as "Moderate" would not be accurate for the view from the village of Creegh itself due to the screening provided by buildings and other structures, and a reduced classification of significance of Not Significant is considered more appropriate.

With the classification of visual effect from the three closest settlements being reduced to Not Significant for the reasons outlined above, the visual effect from the other remaining settlements of Miltown Malbay, Spanish Point, Cranny, Doonbeg, Cappagh, Kilrush, and Moyasta would be no greater than Not Significant and likely Imperceptible in a number of individual cases.

13.7.5 Effects On Other Visual Receptors

13.7.5.1 Transport Route Road User Receptors

The visibility analysis undertaken in Sections 13.6.4 and 13.6.5 identified the N67, N68, R474 and R483/R484 as the key national secondary and regional roads in the vicinity of the site with theoretical visibility.

Within the LVIA study area, the N67 a key coastal driving route and communications route linking the coastal towns running south from Lahinch to the Killimer ferry. Viewpoints 7, 8 and 9 were located along this route, which are considered to result in residual visual effects that are Not Significant, Not Significant and Slight, respectively. Just over a 3 kilometre stretch of the N67 falls within the area that was subject to the route screening analysis, southwest of Mullagh. The distance of the N67 from the site, the general north-south orientation of the road with the site of the proposed development located inland to the east and the primacy of the views towards the coast as opposed to towards the site of the proposed development, all contribute to a long-term, visual effect deemed to be Not Significant.

The N68 is the National Secondary Route between Ennis and Kilrush and viewpoint 3 was selected to represent the view from this route. Given its separation from the site of the proposed development, the entire route also falls outside the area subject to route screening analysis. The southwest-northeast road alignment with the proposed development located six kilometres further north at its closest point, distance from the site of the proposed development and the slight residual visual effect from viewpoint 3, also result in a long-term, slight visual effect from the rest of the N68 within the LVIA study area.

The R474 regional road linking Inagh and Miltown Malbay also lies outside the route screening analysis area, and so is more than five kilometres from the site. Viewpoints 1 and 11 (both resulting in "Slight" visual effects) were selected on this route. It is also a scenic route (SR15) the visual effect from which was considered Not Significant, and this classification of significance can apply to the entire route given the general east-west orientation with the site of the proposed development lying six kilometres to the south at its closest point and the primacy of the views towards the coast and ocean.

The R483/R484 regional roads link the villages of Creegh, Cooraclare and Kilmihil and largely lie within the area where route screening analysis was undertaken. The majority of the R483 and R484 show intermittent screening, which would significantly reduce the full visibility theoretically available as shown on ZTV maps. Viewpoints 4 and 6 were selected on these routes, as were assessed as giving rise to moderate visual effects. The orientation of the two regional roads with the proposed development site lying due east and north, combined with the intermittent roadside screening would further reduce the visual effect of the proposed development from these roads for road users, to a long-term and slight visual effect.

13.7.5.2 Residential Receptors

The residential receptors are residents within the local area and who could have possible theoretical visibility of the proposed wind farm. The closest house to the proposed development is approximately 800 metres from the nearest turbine, which is well outside the setback requirement listed in the Draft Revised Wind Energy Planning Guidelines, 2019.

The majority of the houses evident in the surrounding landscape appear to be in a loose ribbon pattern. The immediate surrounding landscape has very low-density housing. The visual effects on residential receptors are considered for each of the 13 viewpoint locations, where residences are listed amongst the receptors. The potential visual effect from those 13 viewpoints are deemed to be Moderate (5), Slight (4), Not Significant (3) or Imperceptible (1), and in the context of the residential receptors, the effect would be the same and would be long-term.

13.7.5.3 Recreational Receptors

Recreational receptors are considered to have a value and susceptibility to change based on the degree to which views of the landscape are important.

The Wild Atlantic Way, as represented by viewpoints 7, 8, 9, 11 and 12 was also considered in the context of the N67 national secondary road above, and the proposed development was deemed to result in long-term, slight visual effects from this route.

The Cliffs of Moher Coastal Walking Route, Burren Way and Doolin Cycle Hub, as represented by viewpoint 12 are at the very outer periphery of the LVIA study area, and as is the case for viewpoint 12, the visual effect of the proposed development from these recreational areas would be imperceptible.

Only the western-most portion of the Mid-Clare Way falls within the LVIA study area, and the view from it is represented by Viewpoint 2, the visual effect from which is not significant. When the Mid-Clare Way is considered as a whole, the visual effect of the proposed development is further diminished to imperceptible.

The Doughmore Bay & White Strand Beach and Doonbeg International Golf Links are located in the same part of the mid-Clare coast. Although there is no view towards the proposed development from the beach because of the coastal dune system, the view from the golf links is represented by viewpoint 9, the visual effect from which was assessed as being “slight”.

13.7.6 Pattern of Cumulative Visibility

The comparative cumulative ZTV map in Figure 13-16 shows that the comparative cumulative visibility of the existing, permitted and proposed turbines will only increase to an extremely minor extent due to the addition of the proposed ten turbines being added to the “do nothing scenario” landscape.

The addition of the proposed turbines will only result in turbines being visible from a very small additional area in the LVIA study area, compared to where the existing (operational), permitted or other proposed turbines will already be visible from. Therefore, the additional cumulative visibility of the proposed turbines is deemed to be Not Significant, that being an effect which causes noticeable changes in the character of the environment but without significant consequences.

The cumulative visibility of all existing, permitted and proposed wind farms, including the proposed development, as presented in Figure 13-15 shows the difference in landscape and landform across west Clare and how that might influence cumulative visibility. From higher ridges and elevations, the maximum number of turbines will be visible as represented by the yellow colour bands. A large area of yellow is also shown to the southwest of the LVIA study area where the upland plateaux lowers in height towards the coast and the flatter terrain on the approach to the Loop Head peninsula. Across such flat terrain with little undulation in the landscape, longer range views are possible which capture larger numbers of turbines.

On the other end of the cumulative visibility spectrum, the smallest number of cumulatively visible turbines (1-31) are displayed in a green colour band in Figure 13-15. This smallest extent of visibility is concentrated in the east and northeast of the LVIA study area, with other smaller and more isolated areas in the south. The ridgeline of higher ground that spans from Ben Dash to Slievecallan and

onwards towards Lahinch prevents views from the northeast towards the southwest and west, thereby limiting the number of turbines that can be seen.

Between 32-63 turbines are shown to be theoretically visible in the area shown in red in Figure 13-15. This colour band represents the areas where 2-3 wind farms would be visible. With the Slievecallan project consisting of 29 turbines and being the northern-most project considered in the cumulative assessment and ZTV, it is largely contributing to the visibility of this band of turbines.

Although the cumulative visibility analysis covers the entire LVIA study area, the turbines are concentrated in the Slieve Callan Uplands and Kilmihill Farmlands landscape character areas, as envisaged by the Clare Wind Energy Strategy. The fact that wind energy developments in these areas would have been visible from the wider landscape and from landscape areas beyond the two in which the majority are located, would have been considered in the strategic environmental assessment of the Clare Wind Energy Strategy that would have guided the locations of the wind farms in the first instance.

The cumulative visibility along scenic routes in the LVIA study area are considered to be the same as the assessment of significance of effects on the scenic routes presented in Table 13-23, that being "Slight" for SR1 and "Not Significant" for SR15. In the case of both scenic routes, the existing Slievecallan wind farm consisting of 29 turbines is located closer to both scenic routes, and will be more noticeable in the landscape than the proposed development of ten turbines.

Overall, the cumulative visual impact can be described as a Long Term, Slight Cumulative Impact, given the amount of wind farm development that has already occurred and the limited numbers of additional turbines that will come into view as a result of the proposed development. The proposed development does not increase the spatial extent of the area from which any wind turbine will be visible. When viewed cumulatively with the other existing, permitted or proposed wind farms, the proposed development does not transform or redefine the baseline landscape character and is in keeping with current and emerging trends as clearly provided for in and envisaged by the planning policy for wind energy developments in west Clare.

13.7.7 Non-Turbine Landscape and Visual Effects

13.7.7.1 Construction Phase

The construction phase of the proposed development will last approximately 12-18 months. This stage of development will involve the movement of construction vehicles into and out of the site, and the storage of machinery, other equipment, temporary site buildings and building materials onsite. It is considered that this will give rise to temporary visual effects, that will not be significant.

The construction phase of the proposed development will have a slight negative impact on the rural character of the study area, owing to the construction activity itself which will be a temporary change to the do-nothing scenario. It is acknowledged however that the site of the proposed development is part of a working landscape, with extensive commercial forestry activities already underway across the entire site, and renewable energy developments now in operation on adjacent lands.

Construction phase works including the installation of underground electricity cabling can be described as mitigation by design, as there is no potential to give rise to landscape and visual effects and are therefore not considered further in this assessment.

13.7.7.2 Operational Phase

For the purposes of this EIAR, 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. The proposed turbine hardstand areas, construction site compounds, electricity substation compound (and ancillary elements thereto) and borrow pit will all

require the felling of forestry and its replacement with hard surface areas, giving rise to potentially similar landscape and visual effects.

The keyhole felling to be used to clear the areas for these ancillary elements, will leave adjacent forestry to screen the elements from view from the wider area. However, ancillary project elements will be visible in the 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.

13.7.7.2.1 *Road Construction*

Every use will be made of the existing roads on site. Some vegetation clearance will occur as a result of the widening and in the construction of new roadway as part of the proposed development, which will also involve tree felling. The visual impact of the new roads will be localised and will largely not be seen from outside the site due to the setting of most of the turbines locations in forestry. The visual effect of this road widening, is considered long-term, where areas will not be replanted to the edge of the road, localised, but only slight in significance. The visual effect of this road widening, is considered long-term where areas will not be replanted to the edge of the road, localised, but only slight in significance.

13.7.7.2.2 *Meteorological Mast*

The proposed meteorological mast will be a slender structure up to 100 metres in height, and in itself will not be an imposing structure in terms of visual impact and it will also be viewed largely as surrounded by forestry plantation. The landscape impact will primarily constitute clearance around the base of the mast. The visual effect of the proposed anemometry mast 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.

13.7.8 Decommissioning Phase Effects

The landscape and visual effects during decommissioning are anticipated to be the same as during the construction phase, temporary in nature and not significant.

14. CULTURAL HERITAGE

14.1 Introduction

This archaeological and cultural heritage chapter was prepared by Dominic Delany & Associates (DDA). It presents the results of an archaeological and cultural heritage impact assessment for a proposed windfarm at Cahermurphy and adjacent townlands, Co. Clare. The 'Proposed Development' comprises the construction of 10 No. wind turbines and associated infrastructure as described in Chapter 1.

The purpose of this chapter is to assess the potential 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 that was carried out on various dates between August and November 2019.

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 by the Proposed Development. A description of the potential impacts is presented and a number of mitigation measures are recommended where appropriate. The potential visual impact of the proposed development on recorded monuments is also assessed.

14.1.1 Statement of Authority

Dominic Delany BA MIAI graduated from University College Galway in 1986 with a BA (honours) degree in archaeology and history. He is licensed to carry out archaeological excavations in Ireland since 1989 and has over 30 years of experience in the provision of archaeology and cultural heritage services to public and private sector clients. Dominic Delany & Associates was established in 2002 and the company has demonstrated its ability to provide mitigation to developments through management and coordination of projects from pre-planning assessment stage to archaeological resolution of sites. Dominic Delany has undertaken archaeological and cultural assessments for a number of wind farms in the area including the permitted Cahermurphy Wind Farm development.

14.2 Receiving Environment

14.2.1 Planning Background

The planning permission application is for 10 No. wind turbines including associated infrastructure all as described in Chapter 1. There are a number of wind energy projects built, under construction and permitted in the surrounding areas of Glenmore, Booltiagh, Cahermurphy, Letteragh and Boolynagleragh as described in Chapter 2.

14.2.2 Proposed Development

The Proposed Development comprises the construction of up to 10 No. wind turbines with a maximum overall blade tip height of up to 170m; 1 no. permanent Meteorological Mast with a maximum height of up to 100m; 1 no. 38kV electrical substation which will be constructed at one of two possible locations on site; either Option A in Carrownagry South townland or Option B in Cahermurphy townland; all associated underground electrical and communications cabling connecting the turbines to the proposed substation at either Carrownagry South or Cahermurphy; all works associated with connection of the proposed wind farm to the national electricity grid, which will be to the existing Booltiagh 110kV

substation via underground cable; upgrade of existing tracks, roads and provision of new site access roads and hardstand areas; junction access road works, 2 no. borrow pits; 1 no. temporary construction compound, site drainage; forestry felling; and all associated site development works.

All elements of the overall project, including grid connection, forestry felling, as well as the replanting lands have been assessed as part of this EIAR.

The layout of all the above components was designed sympathetically to the known cultural heritage features in the area. Every effort was made to ensure that the project would have the minimum impact possible by placing turbines and access roads in areas which have no above ground archaeological/architectural/cultural heritage features. A full description of the Proposed Development is provided in Chapter 4 of this EIAR.

14.2.3 Site Location and Topography

The Proposed Development is located approximately 5 kilometres to the north of Kilmihil and 25 kilometres southwest of Ennis, Co. Clare. The Grid Reference co-ordinates for the approximate centre of the site are E 108368, N 168989. The site is accessed via local roads and regional roads in the surrounding area.. It is proposed to access the site of the Proposed Development via an existing access track off the local road to the east of the site. This entrance will be widened to facilitate the delivery of the construction materials and turbine components. The site itself is served by a number of existing forest roads. The topography of the area is one of upland blanket bog, most of which is in forestry plantation, with some small parcels of land given over to rough grazing. There is a general slope from the north of the site (140m OD), where an east-west ridge dominates, to lower lying land in the south (90m OD).

14.3 Statutory Context

14.3.1 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 1930-2004 and the relevant provisions of the Cultural Institution 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 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 (Culture, Heritage and the Gaeltacht) and shall not commence the works for a period of two months after having given the notice. All proposed works, therefore, within or around any archaeological monuments are subject to statutory protection and legislation (National Monuments Acts 1930-2004).

Under the Heritage Act 1995 (as amended) 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, 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 or religious history of the place where it is situated or of the country or generally'*.

14.3.2 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 intervention in underpinning conservation policies.

The NIAH was established in 1990 to fulfil 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 Monuments, 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;
- Groups of Buildings: homogenous groups of urban or rural buildings conspicuous 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.

14.3.3 Statutory Consultation

The Department of Culture, Heritage and the Gaeltacht responded to scoping on 19th July 2019. The response stated that the EIAR should contain a detailed cultural heritage section that addresses all built heritage within the footprint of the proposed windfarm. All assessments should be carried out by suitably qualified and suitably experienced archaeological personnel engaged by the client/contractor. Copies of all scoping responses are included in Appendix 2-1 of this EIAR.

14.3.4 Clare County Development Plan 2017-2023

The Clare County Development Plan 2017-2023 outlines a number of objectives relating to archaeological, architectural and cultural heritage. It is a stated goal of Clare County Council to afford *'protection and conservation to buildings, areas, structures, sites and features of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest'* (Goal XIV).

Archaeological Heritage

Development Plan objectives relating to archaeological heritage include:

CPD15.8B: To secure the preservation of all archaeological monuments included in the Record of Monuments and Places, and of sites, features and objects of archaeological and historical interest generally.

CPD15.9: To protect and preserve archaeological sites discovered since the publication of the Record of Monuments and Places.

Architectural Heritage

Development Plan objectives relating to architectural heritage include:

CPD15.1A: To ensure the protection of the architectural heritage of County Clare through the identification of Protected Structures, the designation of Architectural Conservation Areas, the safeguarding of historic gardens, and the recognition of structures and elements that contribute positively to the vernacular and industrial heritage of the County.

CPD15.4A: To seek the retention, appreciation and appropriate revitalisation of the vernacular heritage of County Clare, in both towns and rural areas.

Cultural Heritage

Development Plan objectives relating to cultural heritage include:

CPD15.14: To conserve cultural identity and enhance access to both culturally-distinct areas and facilities for cultural experiences.

14.4 Methodology

The assessment of the archaeology, architecture and cultural heritage of the area of the Proposed Development included desk-based research and field inspection. A desk-based study of the Proposed Development site was 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 site of the Proposed Development. Field walking of the study area was undertaken on a number of dates between August and November 2019 to determine if previously unrecorded archaeological, architectural or cultural heritage features were located in the area of the Proposed Development and to assess any potential impacts on known or previously unrecorded sites or monuments within the EIAR study area. All turbine locations and other infrastructure locations were inspected.

14.4.1 Desktop Assessment

A primary cartographic source and base-line data for the archaeological assessment was the consultation of the Sites and Monuments Record (SMR) and Record of Monuments and Places (RMP) for County Clare. All known recorded archaeological monuments are indicated on six inch Ordnance Survey (OS) maps and are listed in this record. The first edition OS six inch (1840-42) and twenty five inch (1893-1907) maps for the area were consulted. The site of the Proposed Development was inspected by Dominic Delany on various dates between August and November 2019. A photographic record was made of the development area.

The following sources were consulted for this assessment report:

- The Sites and Monuments Record (SMR).
- The Record of Monuments and Places (RMP).
- First edition Ordnance Survey maps (www.osi.ie).

- Third edition Ordnance Survey map (RMP maps for Co. Clare).
- Down Survey maps for County Clare (www.downsurvey.tcd.ie).
- Aerial images (www.osi.ie).
- The Topographical Files of the National Museum of Ireland.
- Excavations Bulletins (www.excavations.ie).
- Clare County Development Plan 2013-2023, Clare County Council.
- County Clare Heritage Plan (2007), Clare County Council.
- National Inventory of Architectural Heritage (NIAH).

14.4.2 Record of Monuments and Places

A primary cartographic source and base-line data for the archaeological assessment was the consultation of the SMR and RMP for County Clare. All known recorded archaeological monuments are indicated on six inch OS maps and are listed in this record. 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 SMR's which may be accessed at www.archaeology.ie was also consulted. There are two recorded monuments within the study area and a further forty-three monuments located within 2km of the study area (see Section 14.5.1.1.5).

14.4.3 Cartographic Sources and Aerial Photography

Down Survey

The Down Survey undertaken by William Petty between 1656 and 1658 was a systematic mapping of Ireland for the purpose of administering the Cromwellian Confiscations. It was based on the earlier Civil Survey and recorded land ownership and features by townland.

The county map does not present much in the way of detail but many of the townlands in the site area are named including 'Knocknahilee' (Knocknahilla More/Beg) and 'Carrownegree' (Carrownagry North/South) in the Barony of Ibrickan in the north, 'Carrowmorehow' (Cahermurphy) in the barony of 'Clanderlagh' (Clonderalaw) in the southeast, and 'Cloghanmore' (Cloghaun More), 'Cloghanbeg' (Cloghaun Beg) and 'Clonewhitt' (Cloonwhite North/South) in the barony of 'Moyfarta Bar' (Moyarta) in the southwest. The barony map for 'Moyfarta Bar' (Moyarta) does not give any detail for the area in the vicinity of the Proposed Development. The barony maps for Ibrickan and Clanderlagh are recorded as having being destroyed in 1717.

Figure 14-1 Down Survey Map of County Clare showing 'Carrowmorehow' (Cahermurphy) in the north of the barony of 'Clanderlagh' (Clanderalaw)

Ordnance Survey first edition six inch map 1840-42

Ireland was included in the British Ordnance Survey beginning in the 1820's and offers a unique record of the country before the changes wrought by the Great Famine of the 1840's. The first edition OS six inch map 1840-42 shows the site of the Proposed Development in bogland with pockets of dispersed settlement and associated improved fields. Cahermurphy is primarily bogland although there are a couple of farmsteads and enclosed fields around Cahermurphy Hill in the south of the townland. The fort crowning the summit of the hill is named 'Cahermurphy' and there are two small lakes to the west. Similarly in Caheraghacullin, Knockhanilamore South and Carrownagry South the landscape is dominated by unimproved bogland but there are a pockets of settlement with some dwellings/outhouses and associated field systems.

Figure 14-2 Ordnance survey map 1840-42 showing Knockahilamore South and Carrownagry South in the north of the development site

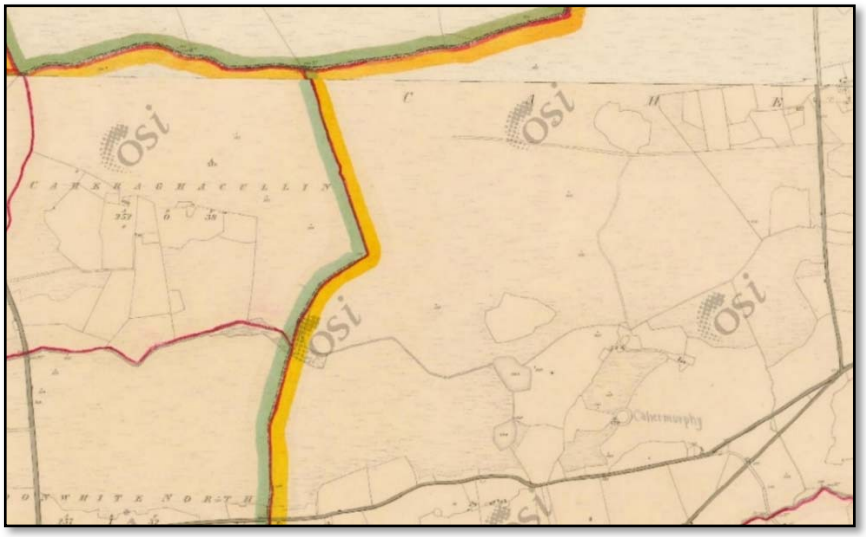


Figure 14-3 Ordnance survey map 1840-42 showing Cahermurphy and Caheraghacullin in the south of the development site

Ordnance Survey first edition twenty five inch map c. 1900

The twenty five inch OS map shows an intensification of land enclosure around existing farmsteads but the site is still largely dominated by bogland.

Aerial Images

A series of aerial images of the site from 1995-2013 were examined on the ordnance survey website www.ois.ie. No new potential archaeological sites were identified and apart from an increase in forestry plantations in the north of site, no significant changes in land usage were noted.

14.4.4 Topographical Files – National Museum of Ireland

Details relating to finds of archaeological material and monuments in numerous townlands in the county are contained in the topographical files held in the National Museum of Ireland. These files were consulted in order to establish if any finds had been recovered from townlands within the study area. The only find recorded is two-handled mether, a type of drinking vessel, which was found in a bog at Cahermurphy. Its National Museum of Ireland number is 1946:353.

14.4.5 Record of Protected Structures (RPS)

The Clare County Development Plan 2017-2023 was consulted for the schedule of buildings (Record of Protected Structures) and items of cultural, historical or archaeological interest which may be affected by the proposed wind farm. The townlands within and surrounding the study area were searched in the list of protected structures in the development plan to assess the proximity and potential impact of the Proposed Development on such structures. The development plan also outlines policies and objectives relating to the protection of the archaeological, historical and architectural heritage landscape of County Clare (see Section 14.3.4). Protected structures/buildings within 5km of the nearest turbines are included here for the purposes of assessing impact on setting in the wider landscape. Protected structures are upstanding buildings/structures which may be prominent in the local landscape so the 5km study area is appropriate in terms of identifying impacts on setting in the wider landscape. The only buildings on the Record of Protected Structures located within 5km of the proposal are St. Michael's Church, Kilmihil (RPS No. 140) 3.75km south of the proposed development site boundary, St. Mary's Church, Finnormore (RPS No. 106) 4km north, Church of The Most Holy Redeemer, Coor West (RPS No. 131) 3.4km northwest, St. Mary's Church, Creegh South (RPS No. 138) 4km west and Creegh Bridge, Creegh South (RPS No. 198) 4.2km west.

14.4.6 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 National Inventory of Architectural Heritage 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 Department of Culture Heritage and the Gaeltacht 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.

Building Surveys

Structures within 5km of the Proposed Development included on the National Inventory of Architectural Heritage are as follows:

Name	St. Michael's Roman Catholic Church
Reg. No.	20404802
Date	1830-1835
Townland	Kilmihil
Co-ordinates	110846, 164287
Distance	3.75km South

Name	St. Mary's Roman Catholic Church
Reg. No.	20403801
Date	1840-1845
Townland	Finnor More
Co-ordinates	104699, 173049
Distance	4km North

Name	Creegh Bridge
Reg. No.	20404705
Date	1800-1840
Townland	Creegh South
Co-ordinates	103416, 166870
Distance	4.2km West

Name	St. Mary's Roman Catholic Church
Reg. No.	20244704
Date	1860-1865
Townland	Creegh South
Co-ordinates	103485, 167027
Distance	4km West

Name	Church of The Most Holy Redeemer
Reg. No.	20203901
Date	1860-1870
Townland	Coor West
Co-ordinates	109212, 173551
Distance	3.4km Northwest

Garden Surveys

The NIAH has begun a process of recording Irelands designed landscapes, specifically demesnes which appeared on the first edition ordnance survey six inch maps. The assigned 'feature richness index' is an assessment of surviving original features and is measured between 1 and 5. There are no recorded designed landscapes within or in the vicinity of the study area.

The objective of the NIAH Garden Survey is to begin a process of understanding the extent of Ireland's historic gardens and designed landscape. Sites were identified using the first edition ordnance survey maps. These were then compared with current aerial photography to assess the level of survival and change. The assessment is not an indication of the sites heritage importance. Fieldwork is now in progress to compile more accurate data and site assessments. The results will be added to the NIAH website as this work progresses.

14.4.7 Excavations Bulletins

Excavations' Bulletins is an annual account of all excavations carried out under licence on the island of Ireland. The database is available online at www.excavations.ie and includes excavations from 1985 to the present. This database was consulted as part of the desktop research for this assessment to establish if any archaeological investigations had been carried out within or near to the area of the Proposed Development. The only entries regarding archaeological investigations in the vicinity of the Proposed Development relate to monitoring for the Cahermurphy Wind Farm development 2019 and the Glenmore Wind Farm development 2017-2019.

Licence No. 19E0089

Excavations Ref.	2019:419
Townland	Cahermurphy
ITM	509970, 669495
Site Type	No archaeology found

Author Dominic Delany

Description: Archaeological monitoring of topsoil and peat removal was carried out on the site of a windfarm development at Cahermurphy, Co. Clare in February and March 2019. The development involved the construction of 3 no. wind turbines, a sub-station and the use of an on-site borrow pit. Nothing of archaeological interest was found during monitoring.

Licence No. 17E0546

Excavations Ref. 2019:420

Townland Glenmore, Boolynamweel, Boolynaknockaun & Furoor (Illaunatoo, Clare)

ITM 514774, 668362 (518558, 668362)

Site Type No archaeology found

Author Dominic Delany

Description: Archaeological monitoring of the construction phase of a windfarm development was carried out between August 2017 and September 2019. The development involved the construction of 12 no. wind turbines, sub-station, anemometry mast, borrow pits, temporary construction compound, new site roads and upgrades to existing tracks and roads. Excavations for Turbines 1-9 were monitored between August 2017 and February 2018 and excavations for Turbines 10-12 were monitored between June and September 2019. No archaeology was found.

Licence No. N/A

Excavations Ref. N/A

Townland Cahermurphy

ITM 509970, 669495

Site Type No archaeology found

Author Dominic Delany

Description: Archaeological monitoring of topsoil removal was carried out during the construction of an access road to service a proposed windfarm development at Cahermurphy, Co. Clare in March 2009. The work also included the excavation of a borrow pit. The borrow pit was at the site of an existing quarry located to the north of the proposed road and on the east side of the existing local road. The existing quarry was extended and gravel and shale extracted for use as road fill. Nothing of archaeological interest was found during monitoring.

14.4.8 Fieldwork

The Proposed Development site was inspected by Dominic Delany over a number of days between August and November 2019. The inspection consisted of an extensive walkover examination of the site and an assessment of any recorded monuments, architectural, built or cultural heritage items. A photographic record of the inspection was made. An inspection of the proposed grid connection route was also undertaken.

14.4.8.1 Limitations Associated with Fieldwork

No significant limitations were encountered during field survey. Dense tree cover within parts of the study area boundary meant the inspection was difficult in some locations but was successfully overcome.

14.4.9 Assessment of Likely Significant Effects

The likely effects on the existing archaeological and cultural heritage environment are assessed using the criteria as set out in the Draft revised guidelines on the information to be contained in Environmental Impact Statements (EPA, 2017). The following terminology is used when describing the likely effects of the Proposed Development from a Cultural Heritage Perspective.

14.4.9.1 Types of Impact

Direct impacts arise where an archaeological heritage feature or site is physically located within the footprint of the Proposed 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 large more significant impact.

Residual impacts are the degree of environmental changes that will occur after the proposed mitigation measures have been implemented.

14.4.9.2 Magnitude of Effects (Significance)

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 1.7.2 of this EIAR.

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 most of the 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.

Imperceptible: An effect on an archaeological site capable of measurement but without noticeable consequences.

14.5 Description of Existing Environment

14.5.1 Archaeological Heritage

For the purposes of this report archaeological heritage includes

- UNESCO World Heritage Sites.
- Archaeological Landscapes or Areas of High Amenity (County Development Plan).
- National Monuments (Ownership, Guardianship and Preservation Orders).
- Recorded Archaeological Monuments listed in the RMP/SMR.
- Newly discovered archaeological sites.
- Sites recorded in the Excavations Database.

14.5.1.1 Proposed Wind Farm Development

14.5.1.1.1 *UNESCO World Heritage Sites*

A World Heritage Site (WHS) is a property inscribed on the UNESCO World Heritage List because of its outstanding universal value. As these sites are categorised as being of international importance, WHS sites within 25km of the proposed turbines were considered for assessment. No monuments on the WHS list and tentative list are located within 25km of the proposed turbines (www.worldheritageireland.ie).

14.5.1.1.2 *National Monuments*

The term '*national monument'* as defined in Section 2 of the National Monuments Act (19300 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 Culture Heritage and the Gaeltacht. Section 5 of the National Monuments Act (1930) allows owners of national monuments to appoint the Minister for Culture Heritage and the Gaeltacht or the relevant local authority as guardian of such monuments, subject to their consent. This means that in effect while the property of such a monument remains vested in the owner, its maintenance and upkeep are the responsibility of the state. Monuments are also protected by Preservation Orders, also National Monuments. As these monuments are categorised as being of National Importance, national monuments within 20km of the proposed turbines were assessed for effect on visual setting. National monutment within 20km of the nearest turbines are included here for the purposes of assessing impact on setting in the wider landscape. A 20km buffer is an appropriate study area in terms of identifying impacts on national monuments in the wider landscape.

National Monument Number 10, an early medieval ecclesiastical site on Scattery Island in the Shannon Estuary south of Kilrush, is located approximately 19.5km southwest of the Proposed Development.

Recorded Monument CL048-005 (Ringfort – cashel), which is located within the EIAR / primary study area boundary as presented in Figure 14-4 , is subject to a Preservation Order made under the National Monuments Act 1930-2014 (PO No. 4/1957) and therefore is also protected under National Monuments Act. This monument is situated near the top of an East (E)-West (W) ridge named Cahermurphy Hill and commands good views especially to the south of the county. It comprises an almost circular cashel (39m E-W; 32m North (N)-South (S)) defined by a well-built drystone wall of small flags (Width 4.5-5.8m; ext. Height 1.6-2.5m; int. Height 1.3-2.2m) with a distinct batter. The original wall-facing is evident from SSW to SSE (max. Height 1.7m). A flat outer terrace is evident SE to WSW and from WNW to N. An entrance (Width 5.2m) at NE may be original. It is partially blocked by a later wall. The interior is

uneven and slopes to S. A well-defined hut site (CL048-005001) abuts the interior of the enclosing wall at N.

Plate 14-1 CL048-005: Cashel (Cahermurphy Fort), view looking north

14.5.1.1.3 Recorded Archaeological Monuments located within study area boundary

Recorded Monuments CL048-005 (Ringfort – cashel) and CL048-005001 (Hut site) are located within the EIAR primary study area boundary for the site of the Proposed Development. CL048-005001 (Ringfort – cashel) is subject to Preservation Order (PO No. 4/1957) and consequently is designated as a National Monument (see Section 14.5.1.1.2). CL048-005001 comprises a hut site (int. dims. 5.5m E-W; 3m N-S) defined by a low drystone wall. It abuts the N interior of CL048-005 (Ringfort – cashel).

Plate 14-2 CL048-005,001: Hut site, view looking southeast

14.5.1.1.4 New Potential Archaeology Recorded Within the Proposed Development Area

All areas proposed for development were examined by a walkover survey. No intrusive investigation was undertaken and the survey was limited to visual inspection only. No new potential archaeological features were noted within the study area boundary. It should be noted however that bogs (both upland blanket peat and raised bogs) are regarded as areas of archaeological potential in terms of the occurrence of monuments and artefacts within and below the peat. In this regard while no new monuments were identified during the field inspection for this assessment, the potential still exists for the uncovering of subsurface remains or artefacts during the construction phase of the project. The potential effect is mitigated against (see below).

14.5.1.1.5 Recorded Archaeological Monuments within 2km of any turbine

For the purpose of assessing effects on the setting of recorded monuments in the vicinity of the Proposed Development, all RMP sites within 2km of the study area are included here. Recorded monutments within 2km of the study area are included here for the purposes of assessing impact on setting in the wider landscape. A 2km buffer is an appropriate study area in terms of identifying impacts on recorded monuments in the wider landscape.

The density of monuments in the area is moderate with forty-three monuments located within 2km of the EIAR study boundary.

These forty-three monuments are included here for the purpose of establishing the archaeological context of the surrounding environs of the Proposed Development site. There are twenty-one monuments located within 2km of the turbine locations. The majority of the monuments were not individually visited, however, being located on private lands. Where possible the nearest point along public roads were utilised for the assessment in consultation with Zone of Theoretical Visibility (ZTV) mapping and Landscape and Visual Impact Assessment (Chapter 13 of the EIAR), particularly for monuments which may be perceived to have visual dominance or prominence within the landscape.

The 43 monuments are listed in Table 14.1 with the distance of the monument to the nearest turbine. The locations are indicated on Figure 14-4.

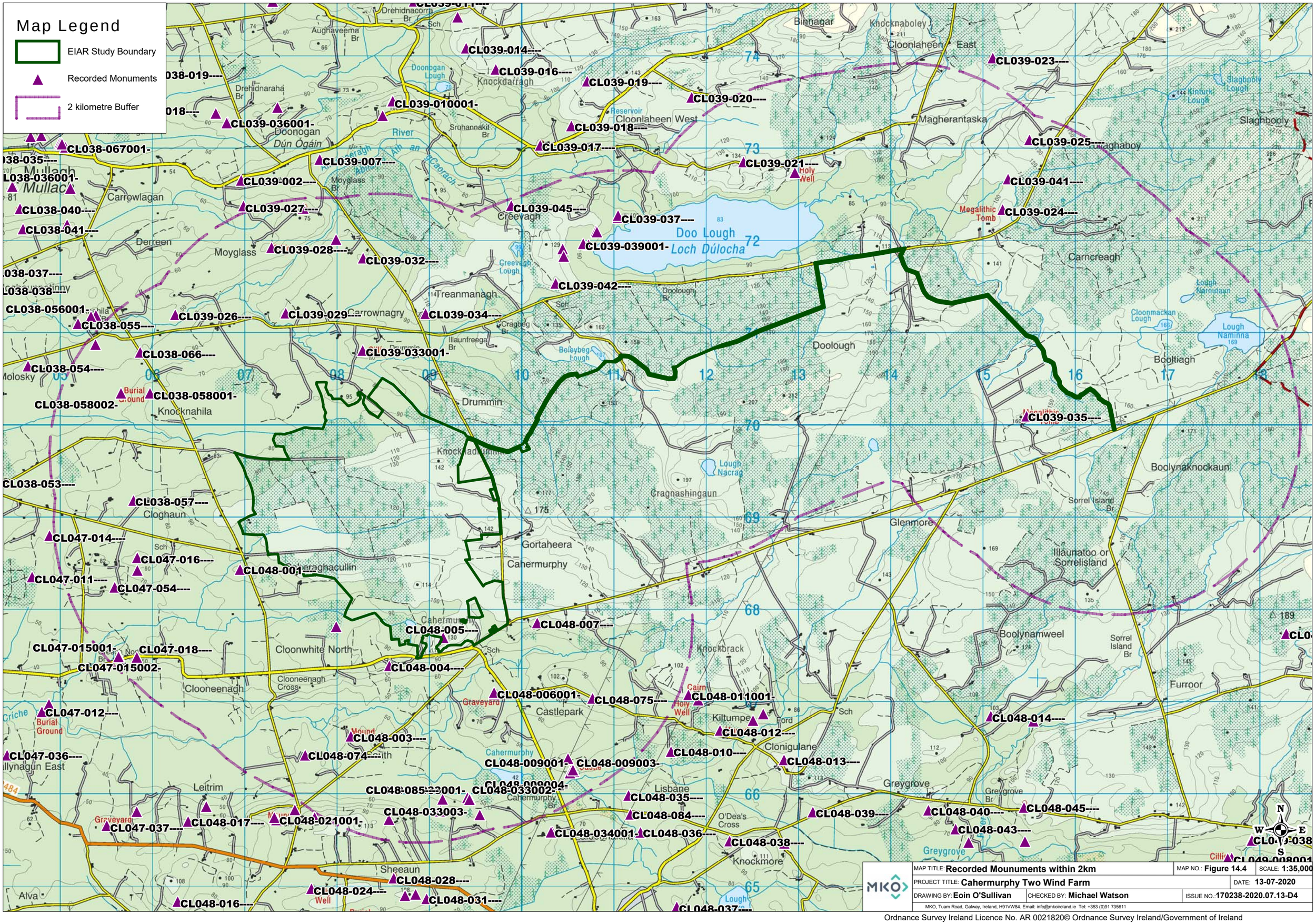
Table 14-1 RMP's within 2km of the EIAR study area

RMP No.	ITM Ref	Townland	Classification	Turbine	Distance (m)
CL038-058001	505940, 670380	Knocknahila More North	Burial ground	1	1750
CL038-058002	505627, 670381	Knocknahila More North	Enclosure	1	2020
CL038-066	505834, 670823	Knocknahila More North	Standing stone	1	2120
CL038-057	505761, 669219	Cloghaun More	Ringfort – rath	1	1630
CL047-015001	505605, 667531	Creegh North	Ringfort – rath	9	2780
CL047-015002	505598, 667525	Creegh North	Souterrain	9	2780

RMP No.	ITM Ref	Townland	Classification	Turbine	Distance (m)
CL047-016	505803, 668598	Cloghaun Beg	Ringfort – rath	1	1760
CL047-017	505804, 668460	Cloghaun Beg	Ringfort – rath	1	1820
CL047-018	505797, 667520	Creegh North	Enclosure	9	2590
CL047-054	505557, 668278	Cloghaun Beg	Cairn – unclassified	4	2360
CL039-026	506241, 671233	Moyglass Beg	Ringfort - rath	1	2190
CL039-027	506957, 672413	Moyglass More	Ringfort - rath	2	2810
CL039-028	507258, 671963	Moyglass More	Children's burial ground	2	2290
CL039-029	507413, 671249	Carrownagry North	Ringfort – rath	2	1560
CL039-030	507602, 672386	Moyglass More	Ringfort - rath	2	2630
CL039-031	507958, 672046	Carrownagry North	Ringfort - rath	3	2210
CL039-032	508249, 671847	Carrownagry North	Ringfort - rath	3	1950
CL039-033001	508247, 670846	Treanmanagh	Children's burial ground	3	980
CL039-033002	508247, 670846	Treanmanagh	Ringfort - rath	3	980
CL039-034*	508927, 671250	Treanmanagh	Redundant record	3	1390
CL048-001	506915, 668474	Cloghaun Beg	Ringfort - rath	4	1050
CL048-002*	507958, 667854	Cloonwhite North	Redundant record	9	490
CL048-003	508121, 666670	Cloonwhite South	Enclosure	9	1530
CL048-004	508538, 667426	Cahermurphy	Ringfort - rath	9	790
CL048-005	509120, 667734	Cahermurphy	Ringfort - rath	10	810
CL048-005001	509116, 667755	Cahermurphy	Hut site	10	810
CL048-006001	509675, 667124	Castlepark	Ecclesiastical enclosure	10	1560

RMP No.	ITM Ref	Townland	Classification	Turbine	Distance (m)
CL048-006002	509671, 667139	Castlepark	Graveyard	10	1560
CL048-007	510137, 667895	Cahermurphy	Hut site	10	1300
CL048-009001	510500, 666279	Castlepark	Moated site	10	2700
CL048-009002	510536, 666281	Castlepark	Castle – tower house	10	2700
CL048-009003	510541, 666283	Castlepark	Enclosure	10	2700
CL048-009004	510495, 666266	Castlepark	House	10	2700
CL048-009005	510527, 666298	Castlepark	House	10	2700
CL048-027	508535, 665759	Sheeaun	Ringfort - rath	9	2430
CL048-032	509090, 668583	Sheeaun	Ringfort – rath	9	2460
CL048033001	509383, 665998	Sheeaun	Ringfort - rath	9	2430
CL048033002	509411, 665983	Sheeaun	Ringfort - rath	9	2460
CL048033003	509405, 665979	Sheeaun	House	9	2460
CL048-074	507623, 666459	Cloonwhite South	Earthwork	9	1860
CL048-075	510737, 667024	Castlepark	Enclosure	10	2260
CL048-082	509517, 665812	Sheeaun	Ringfort - rath	9	2660
CL048-085	509114, 665980	Sheeaun	House	9	2340

* These monuments are redundant records and should not be considered as constraints.



MAP TITLE: Recorded Mounuments within 2km		MAP NO.: Figure 14.4	SCALE: 1:35,000
PROJECT TITLE: Cahermurphy Two Wind Farm		DATE: 13-07-2020	
DRAWING BY: Eoin O'Sullivan	CHECKED BY: Michael Watson	ISSUE NO.: 170238-2020.07.13-D4	

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14.5.1.1.6 Archaeological and Historical Background

Cahermurphy is a townland of 2,424 acres in the Civil Parish of Kilmihil, in the Barony of Clanderalaw, in the County of Clare. The townland takes its name from the Irish *Cathair Mhurchú* meaning the stone fort of Mhurchú. It is in the ancient territory of Corca Bhaiscin East which was co-extensive with the barony of Clanderalaw. This was originally ruled by the O'Donnells and later by the McMahons. The castle of Cahermurphy is mentioned in the Annals of the Four Masters (AFM) as having being plundered by Red Hugh O'Donnell in 1601. The castle is located c. 2km to the southeast of Cahermurphy Fort, in the townland of Castlepark. Cahermurphy is mentioned by Westropp in his 1911 survey of the county:

> *"Cahermurphy takes its name from the strong dry stoned ring wall of Cathair Murchadha in a commanding position at the north end of the valley on a steep green hill, one of the outposts of the plateau from Mount Callan southward where Doolough lies. Passing over the moorland by the road past Doolough House we cross the high boggy ridge of Gortaheera, 580 ft above sea, and as we near the south slope reach a spot commanding a wide view over nearly all the Irrus or South Western extremity of Clare."*

The Prehistoric Period

Standing Stones

Single upright stones are a common feature of the Irish countryside and are known by various names: gallán, dallán, long stone etc. They are not necessarily of the one period or serving the same function. Some have been shown to mark prehistoric burials while others may have a commemorative or ritual function, or served as boundary markers or position posts along ancient routeways (Buckley and Sweetman 1991, 73). They have similar axis to stone rows and pairs and are likely to date to the Bronze Age (2400-5000BC). There is a standing stone (CL038-066) at Knockahila More North to the northwest of the study boundary.

Hut Sites

A hut site is a structure, usually discernible as a low, stone foundation or earthen bank enclosing a circular, oval or sub-rectangular area, generally less than 5m in maximum dimension. The remains are generally too insubstantial to classify as a house but the majority probably functioned as dwellings. These may date to any period from prehistory (c. 8000BC – AD400) to the medieval period (AD 400-1600). There are two recorded hut sites in Cahermurphy; CL048-005001 abuts the enclosing wall within Cahermurphy Fort suggesting it is contemporary with or post-dates the fort, CL048-007 lies to the east of the study boundary.

Cairns

The practice of constructing a mound of stone (cairn) over a burial has a long tradition in Ireland going back to Neolithic times, the practice serving the dual purpose of marking the burial and protecting it. Such mounds may also have been erected for other uses such as boundary markers or memorials to some important event. A cairn is recorded at Cloghaun Beg (CL047-054) .

Early Medieval Period

Ringforts, Raths, Cashels

Ringforts are the most numerous monument type with eight such monuments located within 2km of the study area. Indeed ringforts are the most widely distributed and common monuments in the country. They consist of circular areas, defined by banks and external ditches, and excavation often reveals the remains of dwelling houses and outbuildings for extended families. O' Riordain (1979) described the ringfort as *'a space most frequently circular, surrounded by a bank and fosse or simply a rampart of stone'*. Excavations have revealed that the ringfort was typically an early medieval (AD500-1100) settlement type although some have been shown to predate and postdate this period (Sweetman and O'

Brien 1997, 24). According to Stout (1997) ringforts were *'not built to repel long sieges, or designed to annex territories and populations but rather than to repel the lightning cattle raids, which were endemic during the early medieval period in Ireland'*. In areas where there is little field stone, the banks are generally of earth, while in stony areas, the banks may be of stone, with either stone-cut ditches, or no ditch at all.

Ringforts are usually enclosed by a single bank (univallate) while bivallate and trivallate ringforts, i.e. those enclosed by double or triple rings of banks, are much less common. The number of banks and ditches enclosing these monuments is considered to reflect the status of the site, rather than the strengthening of its defences. The enclosing earthworks would also have protected domestic livestock from natural predators such as wolves and foxes. Archaeological excavation has shown that the majority of ringforts functioned as enclosed farmsteads, built during the early medieval period. 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.

They can be referred to as caiseal, cathair, dún, lios and rath. Rath is the term applied to those with earthen banks while cashel is applicable to those constructed with stone banks. They tend to have a dispersed distribution, although some are occasionally located in pairs, or even joined together. There are nineteen recorded ringfort monuments within 2km of the study area including three in Carrownagry North (CLO39-020, CL039-031 & CL039-032) and two in Cahermurphy (CL048-004 & CL048-005).

Souterrains
Souterrains are underground man-made structures composed of a chamber or series of chambers linked by creepways and entered from ground level by a narrow opening, usually concealed. They are often located within ringforts or cashels, and can also occur in early ecclesiastical enclosures, hut sites and cliff-edge forts. There has been considerable debate about their function; the two most usual suggestions are that they were used for refuge or for storage. There is a souterrain (CL047-015002) within a ringfort (CL047-015001) at Creegh North.

Ecclesiastical Enclosures
An ecclesiastical enclosure is a large oval or roughly circular area, usually over 50m in diameter, defined by banks with external ditches or drystone walls enclosing an early medieval church or monastery and its associated area of domestic and industrial activity. They date to the early medieval period (5th – 12th centuries AD) and in some cases became proto-urban centres whose outlines can be delineated in street plans. An ecclesiastical enclosure is located southeast of the study area in Castlepark (CL048-006001).

Burial Grounds
There are many burial grounds which are not associated with a church. Many are known as 'Children's Burial Grounds' as they were used for the burial of unbaptised children who were not permitted to be buried in consecrated ground. These burial grounds can be found at various locations within fields and ringforts, at boundaries, crossroads and disused or traditional church sites (Farrelly and O' Brien 2002, 282). The practise of burying children in a separate location has a long tradition going back to ancient Greek and Roman times (O'Suilleabhain 1939, 143-5). Throughout Ireland they are variously known as cillín, lisheen, reilir, calluragh, caldragh and ceallunach (Farrelly and O' Brien 2002, 282). Cillíní are often located on or near townland boundaries or in former ecclesiastical sites no longer in use. These liminal spaces were used for the burial of perceived outsiders of one sort or another as well as unbaptised children. Burial Grounds are recorded at Knocknahila More North (CL038-058001), Moyglass More (CL039-028) and Treanmanagh (CL039-033001) and Castlepark (CL048-006002).

Late Medieval Period

Moated Sites
These are square or rectangular enclosures constructed by the Anglo-Normans. Their main defensive feature is a wide, often water-logged, fosse with an internal bank. As in the case of ringforts, these

structures protected settlements; the buildings, usually of wood, seldom leave any surface trace today. According to Barry (1987, 92), 'they probably all functioned as centres of manors from which the Anglo-Norman landowner of the region controlled the feudal system of agriculture. They appear to have been constructed in the late 13th and early 14th centuries, possibly in response to the Gaelic resurgence of this period. There is a moated site at Castlepark (CL048-009001) to the southeast of the study boundary.

Tower House Castles
Tower houses were built in the 15th and 16th centuries as lordly residences by both Gaelic and Old English (Norman) families. The majority are tall rectangular towers, three to five storeys in height, each occupied by one main room and with one, sometimes two, vaulted stone floors. Though not castles in the military sense, they belong to the same tradition and retain many of the features of 'true' castles such as battlements, machicolations, narrow slit windows and, in later examples, gun loops. Many tower house had outer enclosures or bawns, often with corner towers on the angles, and usually built abutting the tower house rather than completely enclosing it. There is a recorded tower house, known as 'Cahermurphy Castle', at Castlepark (CL048-009002).

Miscellaneous

Enclosures
Enclosures are generally circular and are defined by an earth and/or stone bank, sometimes with a fosse. Some are most likely much degraded ringforts or the remains of other monuments such as ring-barrows or henge-type monuments (Farrelly and O'Brien 2002). There are recorded enclosure monuments at Knocknahila More North (CL038-058002), Cloonwhite South (CL048-003), Creegh North (CL047-018), Creevagh ((CL039-042) and two in Castlepark (CL048-075 & CL048-009001).

Earthworks
Earthworks, usually raised, which are either hachured on the OS 6-inch maps or were noted in the field but which could not be classified according to an archaeological site type. In some cases this is because the site is now partially destroyed or levelled; in others because the site type is unique or its nature is unclear. An earthwork monument is recorded at Cloonwhite South (CL048-074).

14.5.1.2 Proposed Underground Cable Grid Connection Route

The proposed windfarm will connect to the national grid via one of the two options. Option A proposes to construct a 38 kV substation at the northern end of the site and to connect from here to the existing Booltiagh 110kV substation, located approximately 7 kilometres to the southeast of the site. Option A also includes for an alternative cable route running from the proposed onsite substation south to the access road and north along the local road to the east of the site. Option B proposes to construct a 38 kV substation to the south eastern end of the site and to connect from here to the existing Booltiagh 110kV substation, located approximately 7 kilometers to the southeast of the site.

14.5.1.2.1 *National Monuments*

No national monuments in state care are located along the proposed grid connection.

14.5.1.2.2 *Recorded Monuments*

No recorded monuments are located along the grid connection route.

14.5.1.2.3 *New potential archaeological sites*

No new potential archaeological sites were noted along the proposed grid connection route during site inspection.

14.5.2 Architectural and Cultural Heritage

For the purpose of this report, architectural heritage includes known (documented) and newly recorded features, if present.

- Record of Protected Structures.
- NIAH structures.
- NIAH Garden Surveys.
- Any other structures / features noted during field assessment.
- Cultural heritage items likely to be effected by the Proposed Development.

14.5.2.1 Proposed Wind Farm Development

14.5.2.1.1 *Protected Structures*

The Record of Protected Structures as listed in the Clare County Council Development Plan 2017-2023 was consulted for protected structures which may be present within the site of the Proposed Development.

No protected structures are located within the EIAR study area boundary, or within close proximity to the study area.

There are five protected structures located within 5km of the study area, namely St. Michael's Church, Kilmihil (RPS No. 140) 3.6km southeast of the study boundary, St. Mary's Church, Finnormore (RPS No. 106) 4km northwest, Church of The Most Holy Redeemer, Coor West (RPS No. 131) 3.1km northeast, St. Mary's Church, Creegh South (RPS No. 138) 4km southwest and Creegh Bridge, Creegh South (RPS No. 198) 4.0km southwest. All five are included in the NIAH survey (see Table 14-2 below)

14.5.2.1.2 *National Inventory of Architectural Heritage - Building Survey*

No structures listed in the National Inventory of Architectural Heritage (NIAH) are located within the site of the Proposed Development. Five NIAH sites are located within 5km of the nearest turbine and are listed below in Table 14-2 and shown in Figure 14-5.

Table 14-2 NIAH Sites located within 5 km of the Nearest Turbine

NIAH Ref.	ITM	Townland	Classification	Turbine	Distance (km)
20404802	510846, 664287	Kilmihil	Church	9	4.6km
20403801	504699, 673049	Finnor More	Church	3	3.7km
20404705	503416, 666870	Creegh South	Bridge	9	5.0km
20244704	503485, 667027	Creegh South	Church	9	5.0km
20203901	509212, 673551	Coor West	Church	1	4.6km

Map Legend

- EIAR Study Boundary
- Record of Protected Structures
- 5 kilometre Buffer

RPS No. 131 Church of the Most Holy Redeemer

RPS No. 106 St Mary's Church

RPS No. 138 St Mary's Church

RPS No. 198 Creegh Bridge

RPS No. 140 St Michael's Church

MAP TITLE: **Protected Structures within 5km**		MAP NO.: **Figure 14.5**	SCALE: **1:60,000**
PROJECT TITLE: **Cahermurphy Two Wind Farm**			DATE: **13-07-2020**
DRAWING BY: **Eoin O'Sullivan**	CHECKED BY: **Michael Watson**		ISSUE NO.:**170238-2020.07.13-D4**

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14.5.2.1.3 National Inventory of Architectural Heritage - Garden Survey

There are no recorded historic gardens/ designed landscapes within the primary EIAR study area, or within 5km of the study area. The primary EIAR study area for the development, is delineated in green on Figure 1.1 of Chaper 1.

14.5.2.1.4 Vernacular Structures

The architectural heritage of the area is characterised by vernacular buildings using local stone in distinctive narrow flat courses. Remnants of such structures from the 18th and 19th centuries survive and are in use as outbuildings, while others are picturesque ruins. Clare County Council recognise the importance of these features in the Clare County Development Plan 2017-2023 (see Section 14.3.4). The first edition six inch (1840-42) and twenty-five inch (1893-1907) ordnance survey maps were analysed for any items of architectural or cultural heritage interest within the primary EIAR study area which may not appear in records such as the RPS or NIAH.

There are no buildings marked within the primary EIAR study area in the townlands of Caheraghacullin and Carrownagry South and the only buildings marked within the study boundary in Cahermurphy townland are those associated with the 'two' farmsteads on the north edge of Cahermurphy Hill. These two sites are now occupied by a modern dwelling and associated modern farm buildings, and it would appear that just one of the nineteenth century buildings survives within the modern farmyard complex.

A number of dispersed buildings are marked across the east-west band of enclosed fields in the north of Knocknahilamore South. Most of the buildings marked on the 1840-42 map are gone by the time of the 1893-1907 map and modern mapping suggests few if any of these buildings survive. The area is now under forestry plantation and it is not known for certain if there are remains of any of these nineteenth century buildings.

The ruins of a vernacular structure, an outhouse or booley hut, was identified in open ground approximately half way between turbine T3 and T5 (Plate 14-3). The building is marked on the 1893-1907 map but not on the earlier map indicating a later nineteenth century date for this structure.

Plate 14-3 Ruin of late 19th century vernacular structure in Carrownagry South, looking west

The roadbridge at Cloghaun Beg to the west of the study boundary is a fine example of the vernacular architecture of the period (Plate 14-4). It takes the form of an impressive wall constructed of blocks and flags of local stone, with two flat-headed culvert–type bridge eye openings. The bridge crosses a stream which flows down from the high ridge of Gortaheera in the north of Cahermurphy and feeds into the Creegh River several kilometres to the west. This stream forms the townland boundaries between Cahermurphy and Knocknahilamore South, and Caheraghacullin and Knocknahilamore South within the primary EIAR study area.

Plate 14-4 Roadbridge at Cloghaun Beg located immediately west of the proposed development site boundary

14.5.2.1.5 Townland Boundaries

Townland boundaries were recorded for the first edition Ordnance Survey mapping of the 19th century. The townlands were then utilised as formal administrative units for the census and as the basic framework for Griffith's Valuation.

Townland boundaries take a variety of forms and may consist of earth and stone banks and associated ditches or stone walls or natural features. Townland boundaries are areas of archaeological potential being liminal spaces often marked in antiquity by ritual, territorial or apotropaic activity.

A number of townland boundaries are located within the site development boundary; a stream forms the townland boundary between Cahermurphy and the townlands of Knocknahilamore South and Carrownagry South to the north, while a stone wall forms its boundary with Caheraghacullin to the west (Plate 14-5).

Plate 14-5 Stone wall forming townland boundary between Cahermurphy and Caheraghacullin, looking north

14.5.2.1.6 Other Cultural Heritage Items

A significant number of field boundaries are indicated on the early ordnance survey maps and are evidence of attempts to farm previously marginal land, a result of the massive expansion of the population of Ireland in the late 18th and early 19th centuries. Many of these boundaries survive today as stone walls and ditches.

There is a well-preserved field wall adjacent to a track in open ground in Carrownagry South (Plate 14-6) located within the primary study area. The wall extends north from the townland boundary with Cahermurphy, crossing a ridge of high ground and eventually linking up with a small settlement cluster in the north of Carrownagry South. This wall is marked on the 1893-1907 map but only partly indicated on the earlier map suggesting it is primarily of later 19th century date.

Plate 14-6 19th century field wall adjacent to modern track in Carrownagry South, looking north

A gate post consisting of a long, narrow limestone slab (Liscannor flagstone) was identified along the route of an existing track in the east of Knocknahilamore South. The slab is rounded on top and perforated for the purpose of hanging a gate. This track is to be upgraded as it forms part of the proposed access road between turbine T2 and T3. A similar gate post stands at the entrance to a field, c. 1km to the west, along the same track.

Plate 14-7 Gate post along route of existing track in the east of Knocknahilamore South

14.5.2.1.7 Language and the Gaeltacht

The site of the Proposed Development is not located within a designated Gaeltacht area, therefore there are no effects on language in this regard (Census 2016, Gaeltacht Areas).

14.5.2.1.8 Place Name Evidence

Place names may be derived from geological, archaeological or topographical features within the landscape or may also have taken the name of an important or famous person who once lived in the area. Place name evidence can refer to archaeological monuments within the vicinity which may no longer be visible in the landscape or which are now only documented through local history or tradition. The database of Irish place names, www.logainm.ie was consulted for the meaning of the place names located within the study area boundary and in the general environs of the site. The following was reported in the database:

Cahermurphy – *Cathair Mhurchú*. No translation is given but the name probably refers to the *'stone fort of Mhurchú'*, in reference to the impressive cashel crowning the summit of Cahermurphy Hill in the south of the townland.

Caheraghacullin – Irish name to be confirmed. O'Donovan suggests the name is derived from *caithreacha cuillinn* meaning '*forts of the holly'* (Ordnance Survey Parish Namebooks, 1838).

Knocknahila More South – Irish name to be confirmed. *'Knock'* from the Irish Cnoc meaning *'hill'* and *'More'* from the Irish Mór meaning *'great or big'* are commonly found in Irish placenames.

Carrownagry South – Irish name to be confirmed. Carrow from the Irish *An Cheathrú* (the quarter) is commonly found in Irish placenames. The *'quarter'* is a reference to a unit of land.

Drummin – Irish name to be confirmed. Drummin from the Irish *An Dromainn* meaning *'ridge'* is commonly found in Irish place names.

Doolough – Doolough takes its name from the *Irish Dúloch* (*Dubhloch)* meaning *'Black Lake'*.

Glenmore – Glenmore takes its name from the Irish *An Gleann Mór* meaning the '*big or great' 'glen'*.

Kiltumper – *Cill Tiompair*. Kil from the Irish Cill meaning *'church'* is commonly found in Irish place names.

Castlepark – *Pháirc an Chaisléan*

Cloonwhite – Irish name to be confirmed. O' Donovan suggests the name is derived from *Cluain Fhaoit* meaning '*Whites meadow, or bog island'*.

Clooneenagh – *Cluain Fhíne*. Cloon from the Irish *Cluain* means a *'meadow or pasture'* is commonly found in Irish place names.

Clogyhaun More/Beg – Irish name to be confirmed. Cloghan may be derived from the Irish *An Clochán* meaning *'the stepping stones'* indicating a way across a river or marsh.

Treanmanagh – Irish name to be confirmed. O'Donovan suggests the name is derived from *Trian Méadhnach* meaning *'the middle third'* (Ordnance Survey Parish Namebooks, 1838).

14.5.2.2 Underground Cabling Grid Connection

The proposed windfarm will connect to the national grid via one of the two options. Option A proposes to construct a 38 kV substation in Carrownagry South at the northern end of the site and to connect from here to the existing Booltiagh 110kV substation, located approximately 7 kilometers to the southeast of the site. Option A also includes for an alternative cable route running from the proposed onsite substation south to the access road and north along the local road to the east of the site.Option B proposes to construct a 38 kV substation in Cahermurphy to the south eastern end of the site and to connect from here to the existing Booltiagh substation.

14.5.2.2.1 *Record of Protected Structures*

No RPS structures are located along the proposed grid connection route.

14.5.2.2.2 *National Inventory of Architectural Heritage Building Survey*

No NIAH structures are located along the proposed grid connection route.

14.5.2.2.3 *National Inventory of Architectural Heritage Garden Survey*

No historic gardens / designed landscapes are located along the proposed grid connection route.

14.5.2.2.4 *Review of Cartographic Sources*

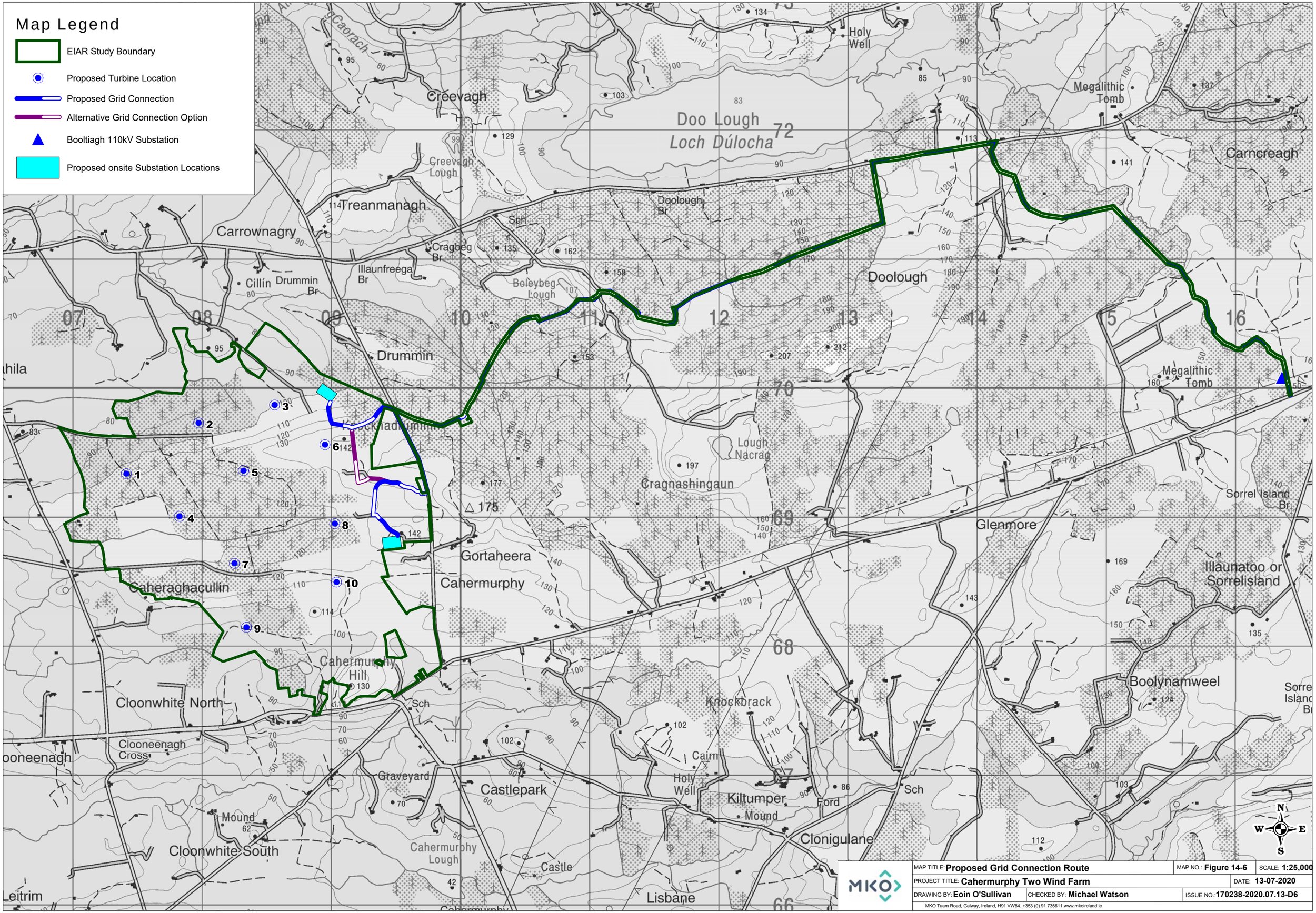
A review of the available historic cartographic sources for the area including the first edition six inch (1840-2) and 25 inch (1893-1907) ordnance survey maps was undertaken for any items of architectural or cultural heritage interest which may not appear in records such as the NIAH or RPS.

The grid connection route in the primary EIAR study area extends northeast through the townlands of Drummin and Doolough, which appear on the 1840-42 OS map as a vast expanse of unimproved bog. The only settlement along the route is a small cluster of buildings and associated network of fields east

of Boleybeg Lough in the townland of Drummin. On the 1893-1907 map the settlement is named 'Boulibeg' and the network of fields has expanded into the surrounding bog. Although most of the buildings are now gone, the two dwellings at the southern extent of the settlement are still occupied and a couple of vernacular buildings survive as ruins along the road leading down to Booleybeg Lough (Plate 14-8).

Plate 14-8 Substantial vernacular structure at 'Boulibeg' in Drummin

At the east edge of forestry in the centre of Doolough the route veers north to join the public road and extends for c. 800m along the road before turning south onto a track and into the east extent of Doolough. The route continues along forest tracks and through forestry adjacent to a small stream which forms the east boundary of the townland. It crosses the small stream into Booltiagh and follows existing forest tracks and wind farm access roads to Booltiagh substation. All of these lands are shown as unimproved bog on the 1840-2 and 1893-1907 OS maps. No buildings or cultural heritage items are marked.



MAP TITLE: **Proposed Grid Connection Route**		MAP NO.: **Figure 14-6**	SCALE: **1:25,000**
PROJECT TITLE: **Cahermurphy Two Wind Farm**			DATE: **13-07-2020**
DRAWING BY: **Eoin O'Sullivan**	CHECKED BY: **Michael Watson**		ISSUE NO.: **170238-2020.07.13-D6**

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14.6 Likely Significant Effects and Associated Mitigation Measures

14.6.1 Do Nothing Scenario

If the Proposed Development were not to proceed, then potential effects on heritage assets as a result of the Proposed Development and associated infrastructure would not apply with no need for mitigation. The existing land-uses on the site of the Proposed Development, predominantly commercial forestry, would continue.

14.6.2 Construction Phase (Direct Effects)

Direct effects refer to a physical effect on a monument or site. The construction phase of the Proposed Development consists largely of earth-moving activities such as peat and topsoil removal for access roads, turbine hardstand areas, sub-stations, borrow pits and excavation associated with the underground cabling grid connection. The potential effects on the known and potential archaeological, architectural and cultural heritage of the area are outlined below with the suggested mitigation measures.

14.6.2.1 Turbines

As no UNESCO World Heritage Sites, National Monuments or Recorded Monuments are located within the footprint of any proposed turbines no direct effects on these aspects of the archaeological resource are identified. Similarly, as no Protected Structures, NIAH structures, historic gardens or items indicated on historic mapping are located within the footprint of any proposed turbines no direct effects on these aspects of the architectural and cultural heritage resource are identified.

14.6.2.1.1 *Effects on unrecorded potential sub-surface sites*

The proposed turbines are mainly located within forestry or immediately adjacent to forestry. Only turbines T6 and T10 are located in open grassland/blanket bog. While no new archaeological sites were detected during the walkover survey the potential exists for the bog to contain as yet unrecorded sub-surface sites and artefacts. It is possible that such sites may be uncovered either within the peat or at the level of the underlying natural subsoil. The excavation of the peat for the turbines and hardstands may effect on any new sub-surface sites, if present.

Pre-Mitigation Impact

Should new sites be present within the peat (currently not visible on the surface) the impact is likely to be significant negative and permanent (i.e. the extraction of peat by machinery would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

Archaeological monitoring of groundworks during construction is deemed to be a suitable mitigation measure. A report on the results of monitoring shall be compiled and submitted to the relevant authorities on completion of the project.

Residual Impact

The sites, if detected, during the pre-construction testing 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 Effects

Based on the assessment above there will be no significant effects.

14.6.2.2 Borrow Pits

As no UNESCO World Heritage Sites, National Monuments or Recorded Monuments are located within the footprint of the proposed borrow pits no direct effects on these aspects of the archaeological resource are identified. Similarly, as no Protected Structures, NIAH structures, historic gardens or items indicated on historic mapping are located within the footprint of the proposed borrow pits no direct effects on these aspects of the architectural and cultural heritage resource are identified.

14.6.2.2.1 *Effects on unrecorded potential sub-surface sites*

The proposed borrow pits are located in grassland over upland blanket bog, close to forestry plantations. There is evidence of some previous ground disturbance, most likely a result of local quarrying, close to but not directly at the sites of both borrow pits. While no new archaeological sites were detected during the walkover survey the potential exists for the bog to contain as yet unrecorded sub-surface sites and artefacts. It is possible that such sites may be uncovered either within the peat or at the level of the underlying natural subsoil. The excavation of the peat for the borrow pits may effect on any new sub-surface sites, if present.

Pre-Mitigation Impact

Should sub-surface archaeological material be present within the proposed borrow pits the impact is likely to be significant negative and permanent (i.e. the removal of topsoil/peat and the extraction of rock by machinery would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

Archaeological monitoring of groundworks during construction is deemed to be a suitable mitigation measure. A report on the results of monitoring shall be compiled and submitted to the relevant authorities on completion of the project.

Residual Impact

The sites, if detected, during the pre-construction testing 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 Effects

Based on the assessment above there will be no significant effects.

14.6.2.3 Sub-Station

As no UNESCO World Heritage Sites, National Monuments or Recorded Monuments are located within the footprint of the proposed sub-station no direct effects on these aspects of the archaeological resource are identified. Similarly, as no Protected Structures, NIAH structures, historic gardens or items indicated on historic mapping are located within the footprint of any proposed sub-station no direct effects on these aspects of the architectural and cultural heritage resource are identified.

14.6.2.3.1 *Effects on unrecorded potential sub-surface sites*

Pre-Mitigation Impact

Should sub-surface sites be present within the proposed sub-station the impact is likely to be significant negative and permanent (i.e. the removal of peat/topsoil would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

Archaeological monitoring of groundworks during construction is deemed to be a suitable mitigation measure. A report on the results of monitoring shall be compiled and submitted to the relevant authorities on completion of the project.

Residual Impact

The sites, if detected, during the pre-construction testing 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 Effects

Based on the assessment above there will be no significant effects.

14.6.2.4 Grid Connection

As no UNESCO World Heritage Sites, National Monuments or Recorded Monuments are located on the route of the grid connection no direct effects on these aspects of the archaeological resource are identified. Similarly, as no Protected Structures, NIAH structures, historic gardens or items indicated on historic mapping are located within the footprint of the proposed grid connection no direct effects on these aspects of the architectural and cultural heritage resource are identified.

14.6.2.4.1 *Effects on unrecorded potential sub-surface sites*

Pre-Mitigation Impact

Should sub-surface sites be present along the proposed grid connection the impact is likely to be significant negative and permanent (i.e. the removal of peat/topsoil would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

Archaeological monitoring of groundworks during construction is deemed to be a suitable mitigation measure. A report on the results of monitoring shall be compiled and submitted to the relevant authorities on completion of the project.

Residual Impact

The sites, if detected, during the pre-construction testing 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 Effects

Based on the assessment above there will be no significant effects.

14.6.2.5 Other Infrastructure

This section relates to other non-turbine elements of the Proposed Development such as access roads, internal underground cabling, construction compounds and any other associated works not discussed in the preceding sections but described in Chapter 4 of this EIAR.

As no UNESCO World Heritage Sites, National Monuments or Recorded Monuments are located within or adjacent to the footprint of other non-turbine elements, no direct effects on these aspects of the archaeological resource are identified. Similarly, as no Protected Structures, NIAH structures or historic gardens are located within the footprint of any associated windfarm infrastructure no direct effects on these aspects of the architectural and cultural heritage resource are identified.

14.6.2.5.1 *Effects on unrecorded potential sub-surface sites*

Much of the proposed infrastructure associated with the Proposed Development is located on existing roads which would be due for upgrade or along firebreaks / forest tracks. However some new access roads, substation, borrow pits, construction compound and a meteorlogical mast are proposed. While no new previously unrecorded sites were noted during field survey it is possible that ground works for the proposed infrastructure may impact on as yet undiscovered sites within the peat or at the level of the underlying natural subsoil.

Pre-Mitigation Impact

Removal of peat and other ground works for the proposed infrastructure may result in a permanent negative significant impact on sub-surface archaeological sites if present.

Proposed Mitigation Measures

Archaeological monitoring of groundworks during construction is deemed to be a suitable mitigation measure since many of the roads are existing with only minor works being proposed to such roads. Some new roads through forestry and bog are proposed however and new potential finds can be dealt with through identification at the monitoring stage. A report on the results of monitoring shall be compiled and submitted to the relevant authorities on completion of the project.

Residual Impact

The sites, if detected, during the pre-construction testing 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 Effects

Based on the assessment above there will be no significant effects.

14.6.2.5.2 *Effects on Cultural Heritage Items*

Proposed new access roads will traverse townland boundaries at three locations within the development site:

- Knocknahilamore South / Carrownagry South between turbine T5 and T6.
- Knockahilamore South / Cahermurphy along the section of link road southeast of turbine T5.
- Cahermurphy / Caheraghacullin on the access road to the met mast.

The proposed access road between turbines T7 and T9 extends north-south immediately east of the stone wall forming the townland boundary between Cahermurphy and Caheraghacullin (See Plate 14-5). To the south of turbine T7 a second access road extends west to the site of a proposed met mast. The construction of the met mast access road will require the removal of a section of the stone wall townland boundary.

There is no surface trace of the townland boundary at the site of the proposed access road between turbine T5 and T6 or at the site of the proposed link road southeast of turbine T5.

Access roads will breach 19th century field walls at some locations within the development site (see Section 14.5.2.1.6).

The proposed upgrading of the access road between turbines T2 and T3 will require the removal of the gate post located at a gateway on the existing road southeast of turbine T2 (see Section 14.5.2.1.6).

Pre-Mitigation Impact

Removal of a section of the stone wall townland boundary between Cahermurphy and Caheraghacullin and sections of other 19th century field walls for the proposed infrastructure will result in a permanent negative impact on this cultural heritage item.

Proposed Mitigation Measures

- Care will be taken to minimise damage to the townland boundary wall during the construction phase.
- The section of stone wall townland boundary which is to be removed to facilitate the construction of the met mast access road will be recorded by means of photographs and a written description prior to removal.
- Groundworks at the three specified townland boundary locations shall be monitored and any sub-surface traces of the townland boundaries shall be recorded by means of photographs, written descriptions and scale drawings if necessary.
- Sections of old field walls which are to be removed to facilitate the construction of access roads and other infrastructure will be recorded by means of photographs and written descriptions prior to removal.
- The gate post will be salvaged and reused at an appropriate location.

Residual Impact

When the suggested mitigation measures are implemented during construction the effects on the townland boundaries and other cultural heritage items will be slight to moderate.

Significance of Effects

Based on the assessment above there will be no significant effects.

14.6.3 Construction Phase (Indirect Effects)

No indirect effects will occur at the construction phase of the Proposed Development. All indirect effects are likely to occur at the operational phase of the Proposed Development (see Section 14.6.5).

14.6.4 Operational Phase (Direct Effects)

No direct effects will occur during the operational phase of the Proposed Development. Any likely direct effects will occur at the construction phase of the Proposed Development (see Section 14.6.2).

14.6.5 Operational Phase (Indirect Effects)

Indirect effects are where a feature or site of archaeological, architectural heritage merit or their setting is located in close proximity to the Proposed Development. Indirect impacts here are mainly concerned with impacts on setting.

Impacts on setting of sites may arise when a development is proposed immediately adjacent to a recorded monument or cluster of monuments. 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 industry-wide approach for assessing the degree of impact to the setting of a monument. For purposes of assessing visual impact on setting, the uniqueness of the monuments, the potential interrelationships of monuments, the inter-visibility of monuments, visual dominance and whether a setting is altered or unaltered can be used to assess impact.

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. Similarly, the extent of the development and its duration and reversibility should all be considered (*Guidelines for Landscape and Visual Impact Assessment 3rd edition* – Consultation Draft, Landscape Institute, 2013).

14.6.5.1 Turbines

14.6.5.1.1 *Impact of turbines on setting of UNESCO World Heritage Sites (Tentative list)*

No monuments on the World Heritage Sites list and tentative list are located within 25km of the proposed turbines.

Pre-Mitigation Impact

No mitigation required

Proposed Mitigation Measures

No mitigation required

Residual Impact

No Impact

Significance of Effects

No Significant Effects.

14.6.5.1.2 *Impact of turbines on setting of National Monuments*

Impact of turbines on setting of National Monuments within 20km of the proposed turbines were considered for purposes of assessing potential impacts on visual setting. The assessments were based on both the ZTV model (as presented in Figure 13-8 of Chapter 13), field survey and the use of photomontages or wireframes where applicable. The National Monuments referred to in Section 14.5.1.1.2 are addressed here in terms of potential impacts on setting.

RMP CL048-005 (Ringfort – cashel), Preservation Order No. 4/1957

Plate 14-9 CL048-005, view looking northeast at monument

Despite its prominent siting on the summit of Cahermurphy Hill, this monument does not have a high visual amenity i.e. its sensitivity to change is considered Low. Indeed, within the local road network the monument is only visible from the immediate environs of the road junction located c. 750m to the east of the monument.

The hill is a prominent feature of the local landscape from this viewpoint but the monument itself is not noticeable. The view is to the east side of the monument, which unfortunately is very poorly-preserved with no facing stones evident and much of the collapsed stone missing (Plate 14-10). When viewed from a distance the cashel wall is indistinguishable from the other field walls on the summit of the hill. At any rate no windfarm infrastructure will be visible in the direct sightline from this viewpoint, as the view is looking west towards the monument and the nearest proposed turbines are over 800m to the north and northwest of the monument. Turbines will be visible within the view to the north of the monument.

There are excellent views from the monument over the low-lying lands of South Clare and the Shannon Estuary (Plate 14-10), and there are good views towards the Atlantic coastline to the west. Views to the east are also expansive and the landscape here is one of upland bog and forestry with the turbines of the Glenmore, Booltiagh and Boolynagleragh windfarms prominent in the landscape (Plate 14-9). Views to the north of the monument are very limited due to the rising topography of the land in the north of Cahermurphy townland. The view to the north is one of rough pasture, bog and forestry plantations (Plate 14-11).

Plate 14-10 CL048-005, view looking SW across S part of monument showing poor condition of east wall (foreground) and good views to South Clare (background)

In conclusion it is considered that the visual amenity of the monument will not be significantly affected by the Proposed Development. The monument does not have a high visual amenity and the only existing local views of the monument, those from the east, will not be significantly affected by the Proposed Development. The good views from the monument to the south and west will not be impacted. The only views from the monument that will be impacted are the limited views of the immediate environs to the north and northwest where turbines and other windfarm infrastructure will be visible (Plate 14-11 and Plate 14-12).

The setting of the monument will be altered in that turbines and other windfarm infrastructure will be visible to the immediate north of the monument.

Plate 14-11 CL048-005, views looking (L) north-northeast across top of wall at west extent of monument and (R) northwest across top of wall in southwest extent of monument

Plate 14-12 View looking north from CL048-005

Plate 14-13 View looking north from CL048-005, photomontage showing permitted and proposed turbines

Pre-Mitigation Impact

The impact on the setting and visual amenity of the monument is deemed to be moderate. As described above, the potential visual impact on the monument is limited by the distance from the Proposed Development but also more importantly the sensitivity of this monument for changes to its setting.

Proposed Mitigation Measures

It is not possible to mitigate against potential negative effects on setting arising from proposed turbines therefore no mitigation measures are proposed.

Residual Impact

The residual impact is the same as the pre-mitigation impact since no mitigation measures are possible.

Significance of Effects

Significant effects on the setting of the monument will not occur due to the distance between the Proposed Development and the monument and also due to the sensitivity of the monument setting to change.The impact on the setting of the monument is deemed moderate.

National Monument No. 10 Early Medieval Ecclesiastical Site, Scattery Island

Pre-Mitigation Impact

At a distance of 19.5km to the nearest proposed turbine, the immediate setting of this monument will not be altered. Turbines from the proposed Cahermurphy Two Windfarm may be visible at a distance to the northeast but there are already several other windfarms built/under construction in this part of West Clare. In this regard the likely effect will be slight.

Proposed Mitigation Measures

It is not possible to mitigate against potential negative effects on setting arising from proposed turbines therefore no mitigation measures are proposed.

Residual Impact

The residual impact is the same as the pre-mitigation impact since no mitigation measures are possible.

Significance of Effects

Based on the assessment above there will be no significant effects.

14.6.5.1.3 *Impact of turbines on setting of Recorded Monuments*

There are 21 monuments within 2km of the nearest proposed turbine location, two of which are located within the primary EIAR study area (as delineated in green on Figure 1.1 of Chapter 1); CL048-005 is subject to a preservation order and therefore categorised as a National Monument (see Section 14.5.1.1.2) and CL048005001 a low visibility hut site located within CL048-005.

The table below presents the recorded archaeological monuments within 2km of any turbine according to their sensitivity (visual dominance, above ground trace, uniqueness, proximity to site etc.) and the likely potential pre-mitigation impact on their setting. For example low visibility monuments such as hut sites, burial grounds, enclosures, earthworks and most ringforts could be considered to have less potential to be impacted by the Proposed Development and therefore their sensitivity could be regarded as low. High visibility monuments such as castles, churches, abbeys and visually dominant monuments on high ground within close proximity to the site of the Proposed Development may be more at risk in terms of impact on their setting. Monuments that do not have any surface trace are not capable of having their setting impacted and these impacts are categorised as 'not significant'.

The majority of the monuments are located on private land with no formal public access. Such monuments can therefore only be viewed/appreciated by the public from the nearest public road. It should be noted that the introduction of the proposed turbines will not impact on the immediate setting of the monuments by virtue of the fact that no recorded monuments are located immediately adjacent to a proposed structure. It is acknowledged, however, that a change to the wider setting of the monuments will occur as a result of the proposed turbines and consequently a minimum slight impact for all upstanding monuments is identified. The likely pre-mitigation impacts for each monument are summarised below.

Pre-Mitigation Impact

Pre-mitigation impacts on the setting of RMP's are set out in Table 14-3 below

Table 14-3 Pre-Mitigation Impacts on setting of RMP's within 2km of EIAR study area

RMP No.	Townland	Classification	Turbine	Distance (m)	Sensitivity of Asset	Significance of Effect
CL038-058001	Knocknahila More North	Burial ground	1	1750	Medium	Slight
CL038-058002	Knocknahila More North	Enclosure	1	2020	Medium	Slight

RMP No.	Townland	Classification	Turbine	Distance (m)	Sensitivity of Asset	Significance of Effect
CL038-066	Knocknahila More North	Standing stone	1	2120	Medium	Slight
CL039-026	Moyglass Beg	Ringfort - rath	1	2190	Medium	Slight
CL039-028	Moyglass More	Children's burial ground	3	2410	Medium	Slight
CL039-029	Carrownagry North	Ringfort - rath	3	1740	Medium	Slight
CL039-031	Carrownagry North	Ringfort - rath	3	2210	Medium	Slight
CL039-032	Carrownagry North	Ringfort - rath	3	1950	Medium	Slight
CL039-033001	Treanmanagh	Children's burial ground	3	980	Medium	Slight
CL039-033002	Treanmanagh	Ringfort - rath	3	980	Medium	Slight
CL039-034	Treanmanagh	Redundant record	3	1390	N/A	N/A
CL038-057	Cloghaun More	Ringfort - rath	1	1620	Low (no trace)	Imperceptible
CL048-001	Cloghaun Beg	Ringfort – rath	1	1020	Medium	Slight
CL047-016	Cloghaun Beg	Ringfort - rath	1	1760	Low (no trace)	Slight Imperceptible
CL047-017	Cloghanu Beg	Ringfort - rath	1	1820	Low (no trace)	Slight Imperceptible
CL048-002	Cloonwhite North	Redundant record	9	490	N/A	N/A
CL048-003	Cloonwhite South	Enclosure	9	1530	Low (no trace)	Imperceptible
CL048-004	Cahermurphy	Ringfort - rath	9	790	Low (no trace)	Imperceptible
CL048-005	Cahermurphy	Ringfort - rath	10	810	High	Moderate

RMP No.	Townland	Classification	Turbine	Distance (m)	Sensitivity of Asset	Significance of Effect
CL048-005001	Cahermurphy	Hut site	10	810	Medium	Slight
CL048-006001	Castlepark	Ecclesiastical enclosure	10	1560	Medium	Slight
CL048-006002	Castlepark	Graveyard	10	1560	Medium	Slight
CL048-007	Cahermurphy	Hut site	10	1300	Low (no trace)	Imperceptible
CL048-074	Cloonwhite South	Earthwork	9	1860	Low (no trace)	Imperceptible
CL048-075	Castlepark	Enclosure	10	2260	Low (no trace)	Imperceptible

Proposed Mitigation Measures

No mitigations proposed

Residual Impact

Same as pre-mitigation impacts

Significance of Effects

Based on the assessment above there will be no significant effects.

14.6.5.1.4 *Impact of turbines on setting of NIAH/RPS structures*

Low visibility structures such as milestones, post boxes, bridges etc. are less likely to have a setting associated with them and are less likely to be visually impacted in contrast to more dominant structures such as houses and churches which often have obvious visible remains.

The sensitivity of an asset together with the distance from the windfarm dictates the significance of potential impacts. These are categorised not based on individual visits (unless publicly accessible) but rather cartographic structures as well as ZTV provided in the LVIA chapter (Chapter 13).

None of the structures listed below will be directly impacted and no significant or adverse impacts will take place. The immediate setting of the structures will not be impacted, however, a change to their wider setting will occur with the introduction of the turbines and therefore a slight impact for the majority of the structures is acknowledged. The ZTV shows that the majority of turbines will be visible from some structure locations within 5km of turbines. The impact on the setting decreases with distance and the sensitivity of the asset. It is also important to note that the ZTV is based on bare landscape without vegetation, tree cover, boundaries which in reality provide screening in the landscape.

Pre-Mitigation Impact

Pre-mitigation impacts on the setting of RMP's are set out in Table 14-4 below

Table 14-4 Pre-Mitigation Impacts on setting of NIAH/RPS structures within 5km of nearest turbines

NIAH/RPS Ref.	Townland	Classification	Turbine	Distance (km)	Sensitivity of Asset	Significance of Effect
140/20404802	Kilmihil	Church	9	4.6	Medium	Slight
106/20403801	Finnor More	Church	3	3.7	Medium	Slight
198/20404705	Creegh South	Bridge	9	5.0	Medium	Slight
138/20244704	Creegh South	Church	9	5.0	Medium	Slight
131/20203901	Coor West	Church	1	4.6	Medium	Slight

Proposed Mitigation Measures

No mitigations proposed

Residual Impact

Same as pre-mitigation impacts

Significance of Effects

Based on the assessment above there will be no significant effects.

14.6.5.1.5 *Impact of turbines on setting of NIAH Gardens*

There are no NIAH historic gardens within 5km of any proposed windfarm infrastructure.

Pre-Mitigation Impact

None

Proposed Mitigation Measures

No mitigation necessary

Residual Impact

No impacts

Significance of Effects

Based on the assessment above there will be no significant effects.

14.6.5.2 Borrow Pits

The operational phase of the proposed borrow pits will not impact on the immediate setting on any cultural heritage features identified in this report. When the borrow pits are operational this is not a development type that would be readily visible in the landscape. No assets are located adjacent to any of the proposed borrow pits. It is proposed to reinstate the proposed borrow pit after its use, however, which will result in a reversal of the borrow pit to its original state.

Pre-Mitigation Impact

Imperceptible

Proposed Mitigation Measures

No mitigation necessary

Residual Impact

None

Significance of Effects

Based on the assessment above there will be no significant effects.

14.6.5.3 Sub-station

14.6.5.3.1 *Impact of Sub-station on Cultural Heritage assets*

The proposed sub-stations are not located immediately adjacent to any designated sites referenced in this report. Visibility of the substations will be localised and predominantly confined to within the proposed development site and therefore, the wider setting of such assets will not be impacted upon by the proposed sub-station locations.

Pre-Mitigation Impact

The substation site and associated electrical equipment may have a slight-imperceptible negative impact on the surrounding archaeological and cultural heritage landscape as it may result in a change to their wider setting.

Proposed Mitigation Measures

No mitigation necessary

Residual Impact

Slight-imperceptible

Significance of Effects

Based on the assessment above there will be no significant effects.

14.6.5.4 Underground Cabling Grid Connection

14.6.5.4.1 *Impact of grid connection on Cultural Heritage assets*

As the site of the proposed grid connection is sub-surface, no indirect effects on setting are anticipated.

14.6.5.5 Other Infrastructure

This section relates to other non-turbine elements. The majority of these elements are low visibility or sub-surface such as proposed access roads, compounds, internal cabling and meteorological mast. The construction compound is also low visibility and temporary and impacts on setting of heritage assets will not occur in this regard.

14.6.6 Cumulative Impacts

Cumulative impact is defined as '*The addition of many small impacts to create one larger, more significant, impact'* (EPA 2002, 33). It is also defined as *'impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project'* (EC 1999). 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 vicinity of the Proposed Development. Cumulative impacts at the Construction, Operational and Decomissioning Stages of the Proposed Development are considered.

Cumulative impacts for the Proposed Development are largely concerned with impacts on setting since no direct impacts on known cultural heritage assets were identified in the EIAR. Cumulative impacts on setting are more likely to occur at the operational stage of the development (i.e. post-construction).

In order to assess the overall cumulative effects on archaeology and cultural heritage the proposed project is considered in the context of other developments including wind farms and renewable energy infrastructure within 20 kilometres of the proposed development and all other projects (i.e. forestry felling, agricultural, residential and other developments within approximately 2 kilometres of the proposed development site and all relevant associated works. The majority of applications in the vicinity relate to the provision and/or alteration of one-off rural housing and agriculture-related structures. Therefore, for the purposes of this assessment and given their potential visibility and scale, the cumulative impacts of existing, proposed and permitted turbines with the addition of the proposed Cahermurphy Two Wind Farm were considered only.

Felling of surrounding commercial forestry will be carried out under the Forestry and Archaeology Guidelines and under licence from the Forestry Service and therefore any potential impact on archaeology and cultural heritage will be considered as part of the felling licence application. It is also noted that there is a noticeable gap in receptors to the east, northeast and southeast of the site where the majority of commercial forestry plantations are located and therefore the cumulative impact on setting from forestry felling with the addition of the proposed development is considered to be negligible.

The replanting lands are located in counties Roscommon, Clare, Galway and Cavan and therefore are not likely to contribute to potential cumulative impacts with the proposed wind farm development in terms of impacts on archaeological and cultural heritage. The potential direct, indirect and cumulative impacts of replanting lands on archaeological and cultural heritage has been assessed in the Section 9 of Appendix 4-3 Assessment of Forestry Replacement Lands.

The projects considered in relation to the potential for cumulative impacts include those as set out in Chapter 2 of this EIAR.

There are a number of operational and proposed wind farms within 20km of the Proposed Development but these impacts must be looked at in the context of the surrounding archaeological landscape. As it stands there is a concentration of RMPs to the north, south and west of the Proposed Development site within the 20km radius. There is a noticeable gap in constraints or receptors to the east of the Proposed Development site. When the locations of the operational and permitted wind farms are taken into consideration, it becomes evident that they are positioned in areas which have fewer archaeological monuments thereby minimising the overall significant negative effects on the archaeological and cultural landscape. When the location of the Proposed Development is taken into consideration the overall negative effect on the archaeological landscape will increase slightly. In general, as the number of wind farms increase, the cumulative impact on the surrounding archaeological resource also has the potential to increase.

It must be noted that this increase in cumulative impact does not result in any direct impacts to archaeology or cultural heritage. Whilst no direct cumulative impacts will occur as a result of the Proposed Development, some indirect visual impact will occur due to the change in the general environment of the landscape.

The addition of 10 turbines is likely to alter the landscape and the general environment within 20km however given the sensitivity of the cultural heritage environment in the vicinity of the Proposed Development is considered Low, the significance of effects will be slight. This conclusion is based on a review of ZTV mapping and a review of the RMPs in relation to other wind farms and the proposed wind farm. Land use and topography must also be taken into consideration and the extent to which the existing environment has been altered in recent decades. Intervening upland areas and hills of which there are many in the vicinity of the Proposed Development also provide screening from turbines. Many wind farms located within 20km of the Proposed Development are also located within coniferous forests and areas which have been subject to clear-felling and replanting as opposed to impacting on an archaeological or cultural heritage landscape.

When considering the proposed wind farm together along with the proposed grid connection route, indirect (visual) effects will not increase since the proposed grid connection is underground thereby avoiding potential negative visual effects on the cultural heritage resource. No increase in indirect cumulative effects will occur therefore.

14.6.7 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 and the established access tracks will be used for the removal of the built features of the Proposed Development.

14.7 Summary

This report comprises an assessment of the potential impact effects of the Proposed Development (including turbines and associated infrastructure, substation, borrow pits, met mast and underground grid connection route and all works described in Chapter 4 of this EIAR).

The potential impacts on the surrounding archaeological, architectural and cultural heritage landscape was assessed. The assessment was based on desktop research and detailed field surveys.

Through a detailed examination of the baseline data available and a detailed site inspection, it was concluded that the archaeological potential of the Proposed Development site is Low. The only area within the EIAR study area deemed to have a high archaeological potential is the immediate environs

of Recorded Monument CL048-005, a National Monument located on the summit of Cahermurphy Hill in the south extent of the study area. No turbines or any other windfarm infrastructure is proposed for this area, the nearest turbine is over 800m to the north of the monument.

Where potential impacts are possible such as effects on as yet unknown sub-surface archaeological features, appropriate mitigation measures have been recommended in order to minimise any such impacts. Recommended mitigation measures include archaeological monitoring during the construction stage of the Proposed Development in terms of potential direct impacts on sub-surface features, if present, and recording of the stone wall townland boundary wall between Cahermurphy and Caheraghacullin prior to removal of a short section of same to facilitate construction of the met mast access road.

Indirect impacts or effects on setting in the wider landscape will result in slight-moderate effects on the setting of archaeological monuments and architectural heritage features. No significant negative effects on setting were identified. The significance of the impacts depends on factors such as the surface remains or otherwise of the monuments, their distance to the turbines being proposed as well as existing topography.

An assessment of cumulative impacts was also undertaken and cumulative impact on setting is likely to increase, although not significantly when considering the proposed, approved, permitted, exising operational and under construction windfarms together.

15. 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'*. They may be either of human or natural origin. The cultural assets of Archaeology and Cultural Heritage are addressed in Chapter 14 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 9: Land, Soils and Geology, Chapter 10: Hydrology and Hydrogeology, and Chapter 11: Air and Climate. Tourism and amenity resources, which are also considered material assets, are addressed in Chapter 5 on Population and Human Health. The Population and Human Health chapter also addresses existing land-uses (economic assets), including forestry and agriculture.

This chapter of the EIAR addresses the likely significant effects of the proposed development on transportation infrastructure (Section 15.1 Traffic and Transport) and on Telecommunications and Aviation (Section 15.2), which are economic assets of human origin.

15.1 Traffic and Transport

15.1.1 Introduction

15.1.1.1 Background and Objectives

The purpose of this section is to assess the effects on traffic and transport of the traffic movements that will be generated during the construction, operational and decommissioning phase of the proposed Cahermurphy Two Wind Farm Development the ('Proposed 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 sized 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. Locations where remedial measures are required to accommodate the abnormal-sized loads are identified.

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 (Construction and Use of Vehicles) Regulations 2003 (S.I. No. 5 of 2003)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. Therefore, the structural integrity of the national and regional road network used during the construction of the proposed development is adequate to provide for these accepted loads.

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 traffic management plan is also provided in Sections 15.1.7 and 15.1.10.6 aimed at minimising the traffic impact on the local highway network. Refer also to Section 6 of the Construction and Environmental Management Plan (CEMP – see Appendix 4-4) for the Traffic Management Plan.

15.1.1.2 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, Derrinlough, 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.

15.1.1.3 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 1.7.2 of this EIAR.

15.1.1.4 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 summarised in Section 2.6 of Chapter 2 of the EIAR. The relevant consultee responses are summarised below:

Transport Infrastructure Ireland

Transport Infrastructure Ireland (TII) responded to Scoping on the 18th June 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, N4, N16 2019.

Clare County Council

A pre-planning meeting was held with Clare County Council on 2nd October 2019. The meeting was attended by a representative of the Planning Department and MKO who indicated that it is proposed to use the same haul route for the proposed development as was used for the permitted Cahermurphy Wind Farm. There was no objection from Clare County Council in principal to the proposals.

15.1.1.5 Methodology and Section Structure

This report adopts the guidance for such assessments set out by Transport Infrastructure Ireland, or TII, in the document PE-PDV-02045 '*Traffic and Transport Assessment Guidelines, May 2014'*. The geometric requirements of the transporter vehicles were assessed using Autocad and Autotrack.

The Traffic and Transport Section of the EIAR 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 15.1.2 - Receiving Environment and 15.1.3 – 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 and decommissioned (Section 15.1.4 – Proposed Development and Traffic Generation),
- A description of the abnormally sized large loads and vehicles that will require access to the site (Section 15.1.5 – 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 15.1.6 –Traffic effects during construction and during operation),
- Identification of traffic management for large deliveries during construction (Section 15.1.7 – 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 15.1.8 – 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 15.1.9 – Provision for Sustainable Modes of Travel),

The description of likely significant effects is provided in Section 15.1.10.

15.1.2 Receiving Environment

15.1.2.1 Site Location

The location of the proposed wind farm development in the townland of Cahermurphy, County Clare, is shown in the context of the national and local highway networks in Figure 15.1.

15.1.2.2 Proposed Abnormal Size Load Delivery Route

It is proposed that large wind turbine components will be delivered to the site of the proposed development, from Dublin Port or Galway Port, via the N68 National Secondary Road. A detailed assessment of the transport route was made from a point at which the route turns off the national road network, the N68 National Secondary Road, at Ballyduneen. The route is shown in Figure 15.1 and is discussed in detail in Section 15.1.8.

For the delivery route further afield the National Road network will provide for the geometric requirements of the abnormally sized loads. This will be confirmed from the port of arrival to the N68 at Ballyduneen, by the delivery company prior to construction.

The extent of the route assessment discussed is therefore confined to the access route comprising of the N68 to Ballyduneen, the R484 to Creegh before turning east on the local road network, through Clooneenagh, turning north towards the site just east of Cahermurphy Hill, as shown in Figure 15.1 and 15.2a. It is noted that this route was used for the delivery of the abnormally sized loads for the Cahermurphy Phase 1 Wind Farm development, although the assessment presented in this EIAR is

based on a larger turbine with a blade length of 68.5m compared to the turbines for Phase 1, which have a blade length of 57m.

15.1.2.3 Proposed Construction Traffic Haul Route

The delivery route for general HGV construction traffic is also indicated in Figure 15.1 with this traffic following a more direct route to the site via the local road network from the village of Kilmihil. It is noted that this route was used for general construction traffic for the Cahermurphy Phase 1 Wind Farm development.

15.1.3 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.

15.1.3.1 Background Traffic Flows

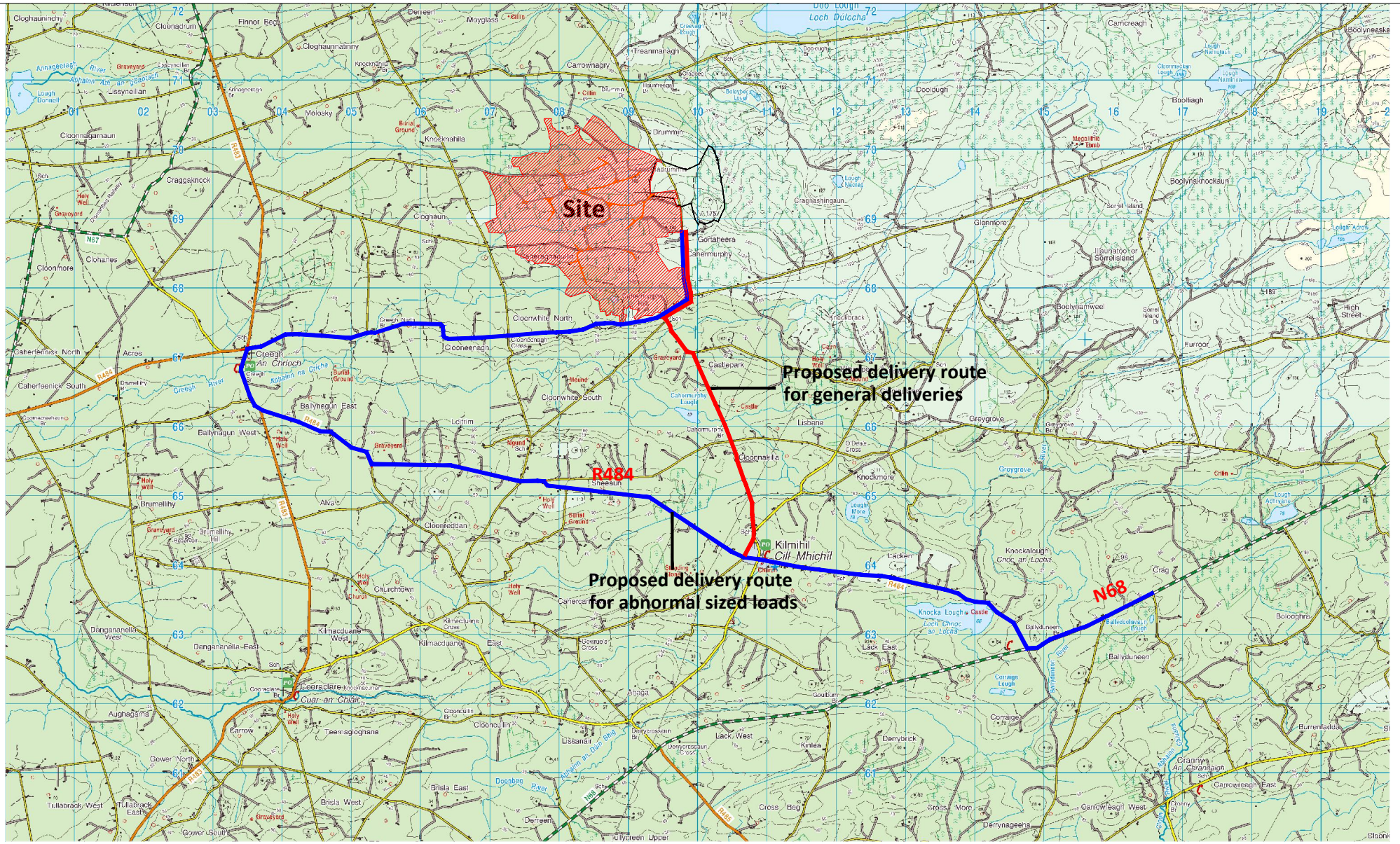
The locations of the link count locations included in the assessment are shown in Figure 15.2b.

A continuous traffic counter is maintained by TII on the N68 just to the south of the junction with the R484 in Ballyduneen. This information; together with a peak period classified turning count undertaken at the junction between the N68 and the R484 at Ballyduneen, locations 1 and 2 shown in Figure 15.2b, and an all-day traffic count on the un-named local road between Creegh and the proposed site, (referred to as Creegh Road in this section of the EIAR), location 3 of Figure 15.2b, on Wednesday 25th September 2019, was used to provide background traffic volumes on the local study road network.

For the peak period count locations (location 1 and 2) daily flow profiles were applied to the short period traffic counts using the data from the continuous traffic counter site on the N68 which shows that the average annual daily traffic flow, or AADT, is 10.84 times the flow observed during the evening peak hour period, as set out in Table 15.1. Base year 2019 traffic volumes for the 3 link locations shown in Figure 15.2b are presented in Table 15.2 and range from 6,406 vehicles per day on the N68 east of Ballyduneen to 1,854 on the R484 leading to Kilmihil, to just 304 vehicles per day on the Creegh Road leading to the proposed site on the delivery route for the abnormally sized roads. Traffic volumes on the local Castlepark Road, which is on the delivery route for general construction traffic, are also low at 200 vehicles per day. This count was obtained from a shorth period traffic count (17:00 to 18:00) and factored to all day using the TII N68 data.

Table 15.1 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 N68 – Ballyduneen	591	17:00 – 18:00	10.84	6,406
2 R484 – Ballyduneen	171	17:00 – 18:00	10.84	1,854



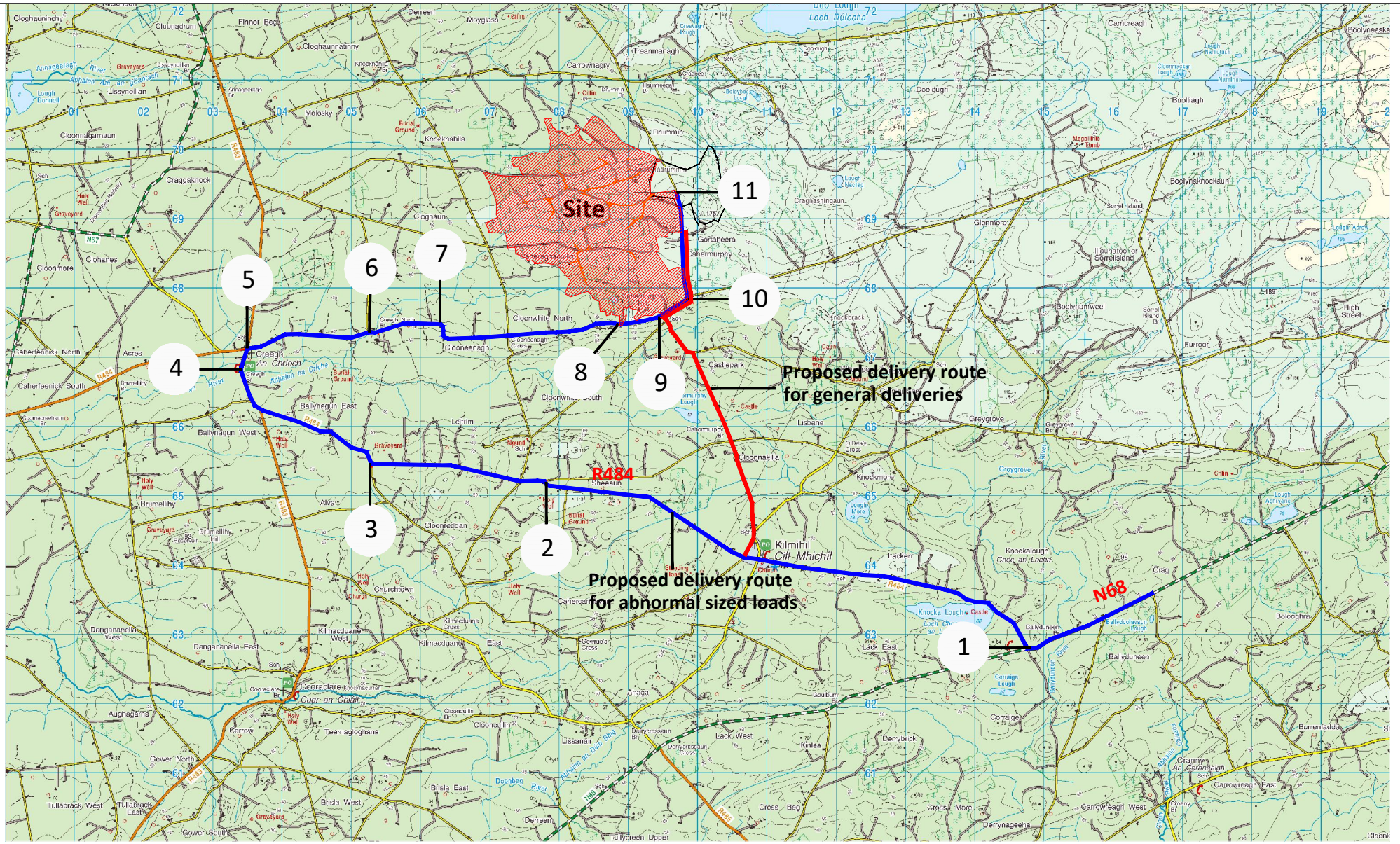
NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Figure 15.1 Site location and delivery route

PROJECT:	Cahermurphy Wind Farm Extension		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte	SCALE:	NTS
PROJECT NO: 3770	DATE: 06.05.20	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS



NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Figure 15.2a Route assessment location plan

PROJECT:	Cahermurphy Wind Farm Extension		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte	SCALE:	NTS
PROJECT NO: 3770	DATE: 06.05.20	DRAWN BY:	AL

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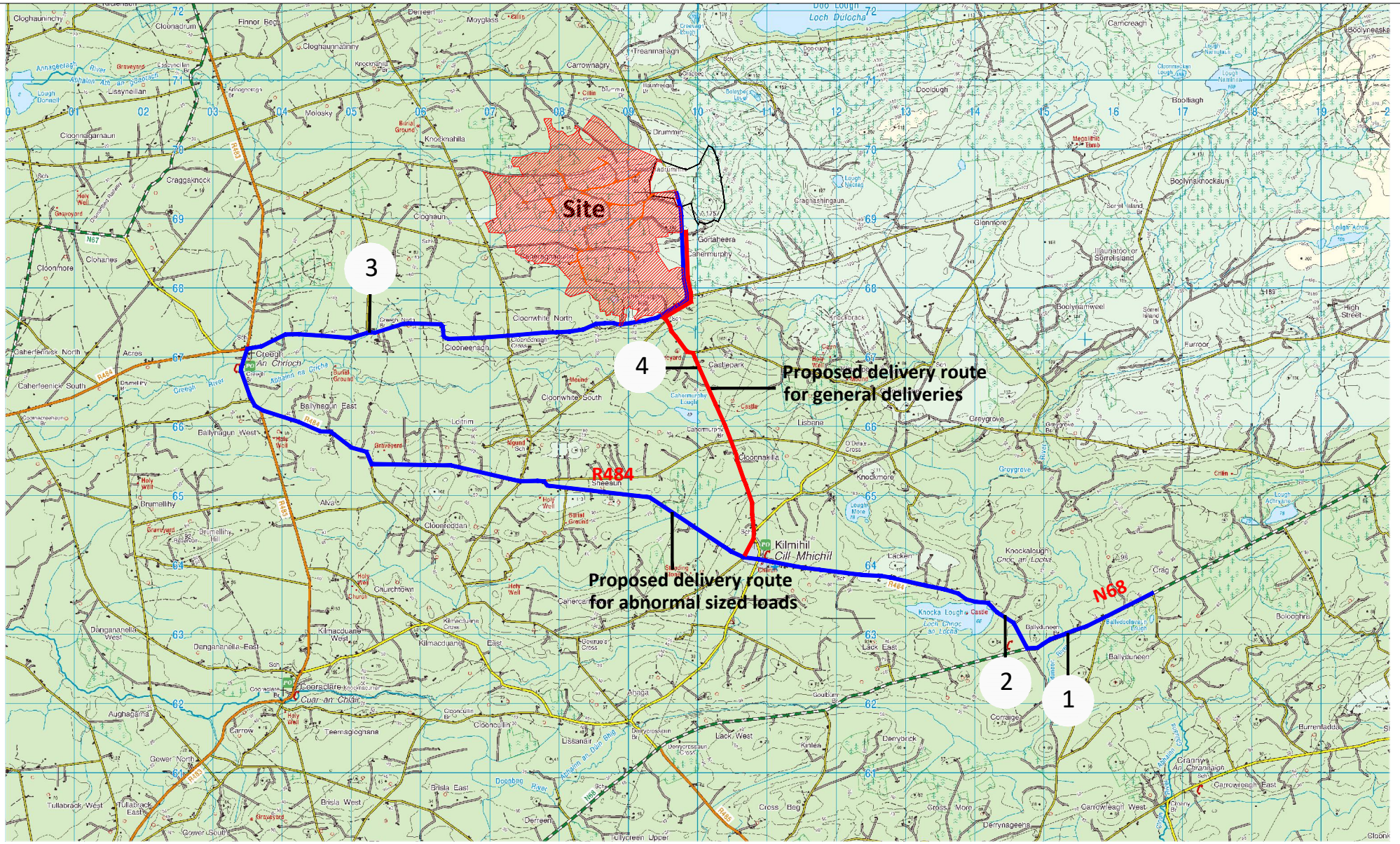


NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Figure 15.2b Link count locations

PROJECT:	Cahermurphy Wind Farm Extension		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte	SCALE:	NTS
PROJECT NO: 3770	DATE: 06.05.20	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS

Table 15.2 Observed all day flows (AADT), year 2019 (2-way vehicles)

Link	2019
1 N68 – Ballyduneen	6,406
2 R484 – Ballyduneen	1,854
3 Creegh Road – Creegh North	304
4 Castlepark Road	200

15.1.3.2 Future Background Traffic Volumes

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 (Unit 5.3). The annual growth rates for light vehicles for County Clare, and factors for the years relevant to this study, are shown in Table 15.3 and Table 15.4, with traffic volumes forecast to increase during the period from 2019 (the observed traffic count year) to 2024 (the assumed construction year based on likely timeframe for statutory planning process) by 4.8%, assuming a medium growth scenario. Year 2019 and 2024 all day traffic flows on the study area network are compared in Table 15.5.

It is noted that while the assumed construction year of 2024 may vary slightly (for example to 2025, this will not alter the forecast outcomes and effects presented in this section of the EIAR.

Table 15.3 TII Traffic Growth Indices for County Clare

Year	Cars and light good vehicles – Annual Factor			Cars and light good vehicles – Cumulative Index		
	Low	Medium	High	Low	Medium	High
2019	1.0139	1.0156	1.0191	101.390	101.560	101.910
2020	1.0139	1.0156	1.0191	102.799	103.144	103.856
2021	1.0139	1.0156	1.0191	104.228	104.753	105.840
2022	1.0139	1.0156	1.0191	105.677	106.388	107.862
2023	1.0139	1.0156	1.0191	107.146	108.047	109.922
2024	1.0139	1.0156	1.0191	108.635	109.733	112.021

Source: TII Project Appraisal Guidelines – Unit 5.3, May 2019

Table 15.4 TII traffic growth rates by growth scenario

Period	New Factors		
	Low	Medium	High
2019 – 2024	1.042	1.048	1.058

The TII traffic count data recorded on the N68 and the all-day traffic count undertaken on the Creegh Road 3 were also used to determine the existing percentage of HGVs on the study area network. The observed percentage of HGVs was observed to vary from 3.5% on the N68, to 7.0% on the Creegh Road approaching the site. Traffic volumes forecast on the study network for the year 2024 are shown by vehicle type in Table 15.6.

Table 15.5 Average all day flows by location and year (2-way vehicles)

Link	2019	2024
1 N68 – Ballyduneen	6,406	6,714
2 R484 – Ballyduneen	1,854	1,943
3 Creegh Road – Creegh North	304	319
4 Castlepark Road	200	210

Table 15.6 All day flows, percentage HGVs and flows by vehicle type, year 2024

Link	All day flow (vehs)	% HGV's	Vehicles		PCUs		
			HGVs	Cars / lgvs	HGVs	Cars / lgvs	Total
1 N68 – Ballyduneen	6,714	3.5%	235	6,479	564	6,479	7,043
2 R484 - Ballyduneen	1,943	3.5%	68	1,875	163	1,875	2,038
3 Creegh Road – Creegh North	319	7.0%	22	296	54	296	350
4 Castlepark Road	210	7.0%	15	195	35	195	230

15.1.4 Proposed Development and Traffic Generation

15.1.4.1 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 –includes for the preparation, groundworks and construction of the turbine foundations, internal cabling and grid connection, access roads, met mast foundations, substation foundations/construction, construction compound and tree felling.
- Stage 2 – Stage 2 includes for turbine delivery and all other conventional deliveries associated with construction of all other elements of the project such as met mast and sub-station.

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. The construction phase of the proposed development will be carried out in accordance with the CEMP, which is submitted as Appendix 4-4 of this EIAR. In the event planning permission is granted for the Proposed Development, the Traffic Management Plan in the CEMP will be updated to address the requirements of any relevant planning conditions, including any additional mitigation measures which are conditioned.

Stage 1 – Site Preparation and Ground Works

The construction phase of the proposed development is expected to last between approximately 12-18 months. For assessment purposes 255 working days have been 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 15.7. This represents the worst case scenario in terms of additional traffic that will travel on the network per day.

During this construction phase, there will be two distinct types of days with respect to trip generation. A total of 10 days will be used to pour the 10 concrete wind turbine foundations. Foundations will likely be poured one per day, with circa 75 concrete loads required for each turbine foundation delivered to the site over a 12-hour period, resulting in an average of just over 6 HGV trips to and from the site per hour. On the remaining 245 working days for this stage, other general materials will be delivered to the site.

During all of Stage 1 it is estimated that 1,932 two-way trips will be made to the site by trucks and large articulated HGVs, as set out in Table 15.7, with the daily effect on the local road network shown in Table 15.8 and Table 15.9.

The figures show that on the 10 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 with 2.4 PCUs per movement), as shown in Table 15.8. Similarly, on the 245 days when other materials will be delivered to the site, traffic volumes on the local network will increase by an average of 23.2 PCUs, as set out in Table 15.9.

Table 15.7 Stage 1 – Site preparation and groundworks – total movements

Material	Total no. Truck Loads	Truck type
Concrete	750	Trucks
Concrete blinding and steel	110	Large artic
Plant / fencing / compound set-up	24	Large artic
Tree felling	623	Large artic
Rock and stone for road capping	20	Trucks
Ducting / cabling	294	Large artic

Material	Total no. Truck Loads	Truck type
Grid cable laying within site (all materials from borrow pits on-site)	0	Large artic
Cranes	11	Large artic
Substation	79	Large artic
Refuelling/ maintenance / waste collection//misc	22	Large artic
Total	1,932	

Table 15.8 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	750	Truck	2.4	1,800	180.0	360.0
* Estimation based on 10 concrete pouring days						

Table 15.9 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	110	Large artic	2.4	263	1.1	2.1
Plant / fencing / compound set-up	24	Large artic	2.4	57	0.2	0.5
Tree felling	623	Large artic	2.4	1,495	6.1	12.2
Rock and stone	20	Trucks	2.4	48	0.2	0.4
Ducting / cabling	294	Large artic	2.4	706	2.9	5.8
Grid cable laying within site (all	0	Large artic	2.4	0	0.0	0.0

Material	Total Truck Loads	Truck type	PCU Value	Total PCUs	PCU Movements /day*	2- way PCUs/day
materials from borrow pits on-site)						
Cranes	11	Large artic	2.4	26	0.1	0.2
Substation	79	Large artic	2.4	190	0.8	1.5
Refuelling/ maintenance / misc	22	Large artic	2.4	52	0.2	0.4
Total	**1,182**	-		**2,837**	**11.6**	**23.2**
* Estimation based on ground work period of 245 working days						

15.1.4.1.1 *Stage 2 – Turbine Construction*

During the turbine construction stage, including delivery and assembly, there will be deliveries to the site made by abnormally large vehicles, referred to in this section as extended artics, transporting the component parts of the turbines (nacelles, blades and towers) and there will 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 15.10, which summarises that a total of 90 trips will be made to and from the site by extended artics, with a further 30 trips made by conventional large articulated HGVs.

Table 15.10 Stage 2 – Wind turbine plant – total movements

Material	Units	Quantity per Unit	Total Quantity	Quantity per Truck	Total Truck Loads	Truck type
Nacelle	10	1	10	1	10	Extended Artic
Blades	10	3	30	1	30	Extended Artic

Material	Units	Quantity per Unit	Total Quantity	Quantity per Truck	Total Truck Loads	Truck type
Towers	10	5	50	1	50	Extended Artic
Sub total					90	
Cables/ controllers	10	1	10	1	10	Large Artic
Blade hub	10	1	10	1	10	Large Artic
Tools and generator	10	1	10	1	10	Large Artic
Sub total				30		
Total				120		

For the purposes of this assessment an assumed delivery period is provided based on actual delivery patterns to recently constructed wind farm developments. Based on this the turbine delivery element will progress at the rate of approximately 3 extended artic trips made by convoy to the site on approximately 2 days per week, resulting in this stage taking approximately 30 days spread over an assumed 15 week period.

On a further two days per week, lasting for approximately 5 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 15.11 and Table 15.12. In Table 15.11 a PCU equivalent value of 10 was allocated to each extended artic movement, resulting in an additional 60 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 15.12, during the turbine construction phase.

Table 15.11 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
Total per turbine	**9**			**90.0**	**180.0**
Total per delivery day	**3**			**30.0**	**60.0**
* Estimation based on 3 abnormal sized loads being delivered per day on 2 days per week (total 90 loads will take 30 nights spread over 15 weeks)					

Table 15.12 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
Cables / controllers	1	2.4	4.8
Blade hub	1	2.4	4.8
Tools and generator	1	2.4	4.8
Total	**3**		**14.4**
* Estimation based on equipment for 2 turbines being moved per week spread over 2 days			

15.1.4.1.2 *Construction Employee Traffic*

It is estimated that a maximum of 70 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 45 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 70 pcu movements (each trip is two way) will be added to the network during the groundworks stage of the development, reducing to 45 pcu trips during the turbine construction stage.

15.1.4.2 Development Trip Generation – During Operation

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 developers, ESB 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 impact on the network of these trips during the operational stage is discussed in Section 15.1.6.

15.1.5 Construction Traffic Design Vehicles

15.1.5.1 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 Cahermurphy Two Wind Farm blades up to 68.5m 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. The worst case scenario of a blade length of 68.5m has been assessed regardless of the make or model of the turbine eventually selected for installation on site. A confirmatory delivery assessment and program will be carried out by the turbine delivery company to ensure the findings of this assessment remain valid for whatever model of turbine is selected.

For the purpose of the assessment set out in this EIAR, it is assumed that the blades, which are the largest turbine components, will be transported using a standard extended arctic. As this method involves transporting the blade in a horizontal position it represents the worst case in terms of the geometric requirements on the road network. It is noted, however, that during the delivery phase consideration will be given to using alternative transportation technologies, including the use of scissor lift adaptors which raise the rear of the blade over existing obstructions, and in extreme cases, the use of blade lift adaptors that can transport blades at an angle to both lift the rear of the blade and shorten the wheelbase of the transporter.

The key dimensions of the vehicles tested are as follows:

Transport of Blades – Articulated HGV with blade

Total length	74.6 m
Length of blade	68.5 m
Inner radius	25.0 m

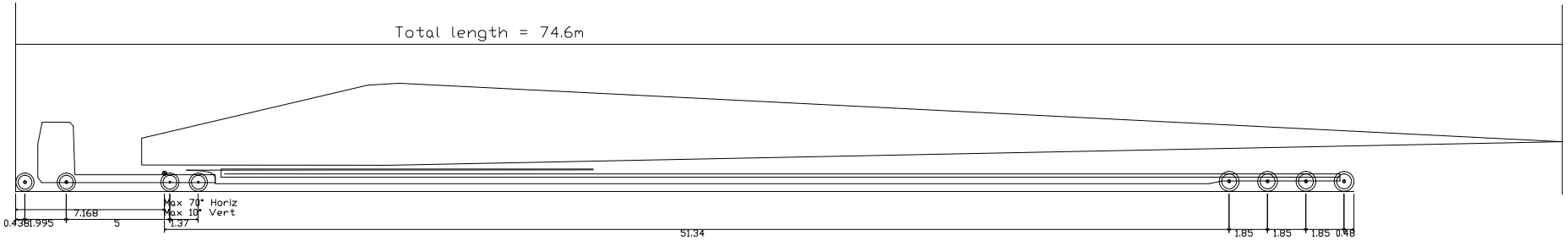
Transport of Tower – Using low-bed or drop deck trailers

Total length (with load)	46.7 m
Length of load	29 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 15.1.8 are the blade transporter and the tower transporter with the geometry of each shown in Figure 15-3 and Figure 15-4 respectively.

The vehicles used to transport the nacelles will be similar to the tower transporter although will be shorter in length.

All other vehicles requiring access to the site will be standard HGVs and will be significantly smaller than the design test vehicles.



68.5 m blade

Overall Length (vehicle only)	64.537m
Overall Width	2.550m
Overall Body Height	4.800m
Min Body Ground Clearance	0.375m
Track Width	2.500m
Lock to Lock Time	6.00s
Wall to Wall Turning Radius	9.800m

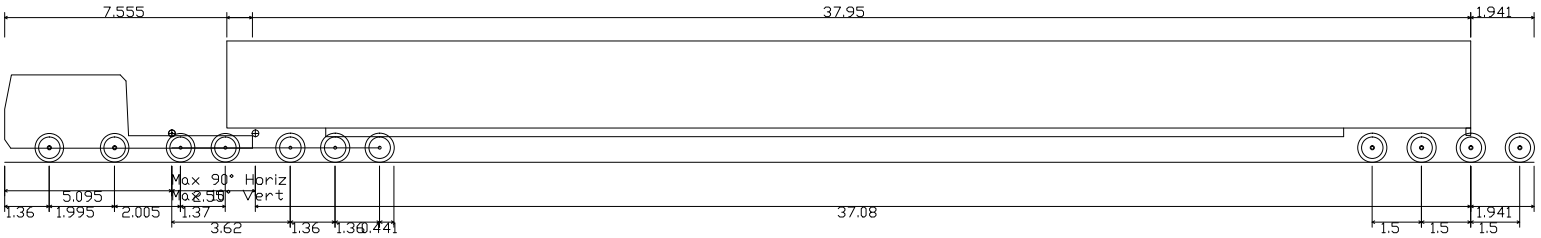
NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Figure 15.3 Design blade extended artic profile

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte	SCALE:	NTS
PROJECT NO: 3770	DATE: 04.10.19	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS



Siemens Tower 46.75 (Final)

Overall Length	46.666m
Overall Width	2.550m
Overall 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:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Figure 15.4 Design tower extended artic profile

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte		SCALE: NTS
PROJECT NO: 3770	DATE: 04.10.19		DRAWN BY: AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS

15.1.6 Traffic Effects During Construction and During Operation

15.1.6.1 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 and development generated traffic volumes are shown for the typical construction day scenarios discussed in Section 15.1.4 are set out in Table 15.13, Table 15.14, Table 15.15 and Table 15.16 with the traffic effects summarised in Table 15.17, Table 15.18, Table 15.19 and Table 15.20. The actual figures presented in the tables will be subject to change, however they are considered to represent a robust worst case estimation of the likely effects.

In terms of daily traffic flows the potential effects may be summarised as follows:

During Stage 1 - Site Preparation and Groundworks

On average an additional 93 PCUs will travel on the local highway network resulting in a percentage increase in traffic volumes on the study network of between 1.3% on the N68 and 4.6% on the R484 between Ballyduneen and Kilmihil. On Castlepark Road approaching the site traffic volumes are forecast to increase by 40.4% on these 245 days.

During Stage 1 – Concrete Pouring

For these 10 days an additional 430 PCUs will travel on the study network. On these days, the percentage increase in traffic volumes experienced on the study network will be between 6.1% on the N68 and 21.1% increase on the R484 between Ballyduneen and Kilmihil. As the local Castlepark Road currently provides for very low traffic volumes, traffic volumes on this road are forecast to increase by a factor of almost 3 (+186.8%) on these days.

During Stage 2 - Turbine Construction Stage – Delivery of large equipment using extended articulated vehicles

The additional 105 PCUs (made up of cars and large extended artics) will appear on the study network for 30 days. On the days this impact occurs, volumes will increase by 1.5% on the N68 to the east of the N484, by 17.2% on Creegh Road and 19.6% on Castlepark Road 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 15.1.7 and 15.1.10.6 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 10 days on the delivery route 60 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 0.9% on the N68 and 2.9% on the R484. Volumes on Castlepark Road are forecast to increase by 26.1% on these days.

Table 15.13 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 N68 – Ballyduneen	6,479	564	7,043	70	360	430	6,549	924	7,473
2 R484 - Ballyduneen	1,875	163	2,038	70	360	430	1,945	523	2,468
3 Creegh Road – Creegh North	296	54	350	0	0	0	296	54	350
4 Castlepark Road	195	35	230	70	360	430	265	395	660

Table 15.14 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 N68 – Ballyduneen	6,479	564	7,043	70	23	93	6,549	587	7,136
2 R484 – Ballyduneen	1,875	163	2,038	70	23	93	1,945	186	2,131
3 Creegh Road – Creegh North	296	54	350	0	0	0	296	54	350
4 Castlepark Road	195	35	230	70	23	93	265	58	323

Table 15.15 Development traffic during turbine construction - extended artics

Link	Background PCUs			Development PCUs			Total PCUs (Background + Development)		
	Car	HGV	Total	Car	HGV	Total	Car	HGV	Total
1 N68 – Ballyduneen	6,479	564	7,043	45	60	105	6,524	624	7,148
2 R484 – Ballyduneen	1,875	163	2,038	45	60	105	1,920	223	2,143

Link	Background PCUs			Development PCUs			Total PCUs (Background + Development)		
3 Creegh Road – Creegh North	296	54	350	0	60	60	296	114	410
4 Castlepark Road	195	35	230	45	0	45	240	35	275

Table 15.16 Effect of development traffic during turbine construction – other deliveries

Link	Background PCUs			Development PCUs			Total PCUs (Background + Development)		
	Car	HGV	Total	Car	HGV	Total	Car	HGV	Total
1 N68 – Ballyduneen	6,479	564	7,043	45	15	60	6,524	579	7,103
2 R484 – Ballyduneen	1,875	163	2,038	45	15	60	1,920	178	2,098
3 Creegh Road – Creegh North	296	54	350	0	0	0	296	54	350
4 Castlepark Road	195	35	230	45	15	60	240	50	290

Table 15.17 Summary effect of development traffic during concrete pouring

Link	Background	Development	Total	% increase	Estimated No. of days
1 N68 – Ballyduneen	7,043	430	7,473	6.1%	10
2 R484 - Ballyduneen	2,038	430	2,468	21.1%	10
3 Creegh Road – Creegh North	350	0	350	0%	0
4 Castlepark Road	230	430	660	186.8%	10

Table 15.18 Summary effect of development traffic during site preparation and ground works

Link	Background	Development	Total	% increase	Estimated No. of days
1 N68 – Ballyduneen	7,043	93	7,136	1.3%	245

Link	Background	Development	Total	% increase	Estimated No. of days
2 R484 - Ballyduneen	2,038	93	2,131	4.6%	245
3 Creegh Road – Creegh North	350	0	350	0%	0
4 Castlepark Road	230	93	323	40.4%	245

Table 15.19 Summary effect of development traffic during turbine construction – extended artics

Link	Background	Development	Total	% increase	Estimated No. of days
1 N68 – Ballyduneen	7,043	105	7,148	1.5%	30
2 R484 - Ballyduneen	2,038	105	2,143	5.2%	30
3 Creegh Road – Creegh North	350	60	410	17.2%	30
4 Castlepark Road	230	45	275	19.6%	30

Table 15.20 Summary effect of development traffic during turbine construction – other deliveries

Link	Background	Development	Total	% increase	Estimated No. of days
1 N68 – Ballyduneen	7,043	60	7,103	0.9%	10
2 R484 - Ballyduneen	2,038	60	2,098	2.9%	10
3 Creegh Road – Creegh North	350	0	350	0.0%	10
4 Castlepark Road	230	60	290	26.1%	10

An assessment of the impact on link capacities in the study area was undertaken for the various construction stages as set out in Table 15.21, Table 15.22, and Table 15.23. The capacity for each link in the study area is shown in Table 15.21. The capacities range from a daily flow of 8,600 vehicles on the N68 to 5,000 on the R484 and are based on road widths and capacities set out in the Transport Infrastructure Ireland Standards document DN-GEO-03031 Road Link Design, Table 6/1. For the local Creegh Road and Castlepark Road which have sections where only one way operation is possible, the link capacity was reduced to 2,200 PCUs per day based on rural link design guidelines.

Background, or do nothing traffic flows, are compared to flows forecast for the various construction delivery stages in Table 15.22 with the percentage capacity reached for each link and stage shown in Table 15.23. Based on this assessment the following points are noted;

- On the external network the N68 is the busiest road with the link capacity forecast to operate at 82% for the do-nothing scenario, increasing to a maximum of 87% during the 10 days that the concrete foundations will be poured.
- The Local Creegh Road is forecast to operate well within capacity for all scenarios, increasing from 16% for the do-nothing scenario to a maximum of 19% on the 30 days that the abnormal deliveries will be made to the site.
- The Local Castlepark Road is also forecast to operate within capacity for all scenarios, increasing from 10% for the do-nothing scenario to a maximum of 30% during the 10 days that the concrete foundations are poured.

Table 15.21 Carriageway widths, link type and link capacity

Link	Width (m)	Link type	Link capacity
1 N68 – Ballyduneen	7.0	Type 2 single	8,600
2 R484 – Ballyduneen	6.0	Type 3 single	5,000
3 Creegh Road – Creegh North	<5.0	NA	2,200
4 Castlepark Road	<5.0	NA	2,200

Table 15.22 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 extended artics	Other turbine equipment
1 N68 – Ballyduneen	8,600	7,043	7,473	7,136	7,148	7,103
2 R484 - Ballyduneen	5,000	2,038	2,468	2,131	2,143	2,098
3 Creegh Road – Creegh North	2,200	350	350	350	410	350
4 Castlepark Road	2,200	230	660	323	275	290

Table 15.23 Link capacity and % of link capacity by construction delivery stage

Link	Link capacity	Construction delivery stage				
		Background traffic	Concrete pour	Other site works	Turbine extended artics	Other turbine equipment
1 N68 – Ballyduneen	8,600	82%	87%	83%	83%	83%
2 R484 – Ballyduneen	5,000	41%	49%	43%	43%	42%
3 Creegh Road – Creegh North	2,200	16%	16%	16%	19%	16%
4 Castlepark Road	2,200	10%	30%	15%	13%	13%

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 and associated compound. The construction of the substation will take place at the same time as the site preparation and groundworks stage, as set out in Table 15.7 and Table 15.8, and traffic effects included in the assessment for that construction period.

Effect on Link Flows – During Operation

Once the wind farm is operational it is estimated that there will be approx. 2 staff members employed on site 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

Guidance relating to the requirement to undertake a detailed junction capacity assessment at junctions in the proximity of a proposed development is set out in Document PE-PDV-02045 Traffic and Transport Assessment Guidelines, TII, May 2014. The guidance states that a capacity assessment should be undertaken where the proposed development results in an increase in traffic volumes of 10% or greater, in situations where the network is not currently congested. As the traffic volumes on the R484 are forecast to increase by greater than this threshold (+17.6%) during the construction of the Proposed Development on the 10 days that concrete is delivered to the site, a detailed capacity assessment was undertaken for the existing N68 / R484 junction at Ballyduneen.

While traffic volumes on the local road network are also forecast to increase by > 10% during the construction of the Proposed Development, however existing traffic volumes on the local road network are very low, and, as a result, junction capacity is not considered to be an issue on the remainder of the route.

The capacity of the N68 / R484 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 15.17, Table 15.18, Table 15.19 and Table 15.20 above, the worst-case effect will be experienced during peak hours when, during peak construction periods, up to 70 workers (35 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.

N68 / R484 junction Capacity Test Results

The AM and PM peak hour traffic flows through the N68 / R484 junction are shown for the year 2019 in Figure 15-5a, with background traffic flows for the assumed construction year of 2024 shown in Figure 15-5b. Traffic flows generated by the proposed development during the AM and PM peak hours are shown in Figure 15-5c while the year 2024 traffic flows with development generated traffic are shown in Figure 15-5d.

The results of the capacity assessment, as set out in Table 15.24, 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 11.3% to 18.2% in the AM peak hour, and from 12.4% to 19.5% during the PM peak hour, which is within the acceptable limit of 85%.

Table 15.24 Junction capacity test results, N68 / R484 junction, AM and PM peak hours, without and with construction staff, year 2024

Period	Location	Without construction traffic			With construction traffic		
AM		RFC	Queue (vehicles)	Delay (minutes)	RFC	Queue (vehicles)	Delay (minutes)
	From R484	23.3%	0.30	0.16	23.4%	0.30	0.15
	Right turn from N68	11.3%	0.13	0.12	18.2%	0.22	0.13
PM		RFC	Queue (vehicles)	Delay (minutes)	RFC	Queue (vehicles)	Delay (minutes)

Period	Location	Without construction traffic			With construction traffic		
	From R484	12.4%	0.14	0.13	19.5%	0.24	0.14
	Right turn from N68	23.4%	0.30	0.14	23.4%	0.30	0.14

Effect on Junctions – During Operation

As discussed in Section 15.1.6 it is forecast that once operational, the development will generate approx. 2 trips per day for maintenance purposes. It is therefore concluded that the development will have an imperceptible effect on the local network once constructed.

Effect on Network of Grid Connection

The planning application includes 2 No. substations and one associated grid connection, however only one substation will ultimately be constructed. It is proposed to construct a 38kv substation at the site and to connect from here to the existing Booltiagh substation, located approximately 7 kilometres to the southeast of the site. Connection via the Booltiagh route would comprise underground cabling, measuring approximately 12.1 kms in total, located on existing forestry and agricultural land and within the public road corridor. The electrical substation will have a control building, associated electrical plant and equipment, and waste water holding tank.

The proposed grid connection route is shown in Figure 4.16 of Chatper 4.

The cable route will cross 2 local roads on route to the Booltiagh substation and will also have an impact on 2 sections of the local road network as shown in Figure 15-6 and Figure 15-7.

The connection will be installed by 2 teams, with each team laying approximately 150 metres of cable per day, equating to a total of 300 metres per day. For both road closure sections A and B a localised closure will be required as they are not wide enough to accommodate both the construction works and one live lane of traffic. For section A 0.7km of local road will be affected, which will require a road closure for approximately 2.3 days with a suitable diversion provided via a local road located 2.5kms to the west, as indicated on Figure 15-6, resulting in a maximum detour of 12.6kms. For section B a 1.0km section of road will be affected which will require to be closed for 3.3 days resulting in a maximum diversion of 23.1 kms. For both roads affected traffic volumes are low, as will the number of trips affected during the total of 4.6 days when a road closure will be required. It is also noted that the diversions shown on the figures and quoted above are the mximum possible diversions that could be incurred, with most actual journey distances increasing by a significantly lower margin. Details of all water crossings are shown in Figure 4.26 of Chapter 4.

The construction methodology of providing a cable route under and along local road networks is well established and accepted nationwide. There are in excess of 270 wind farms currently operational in Ireland and the majority of these are connected to the national grid via underground cable connections predominantly along the public road networks.

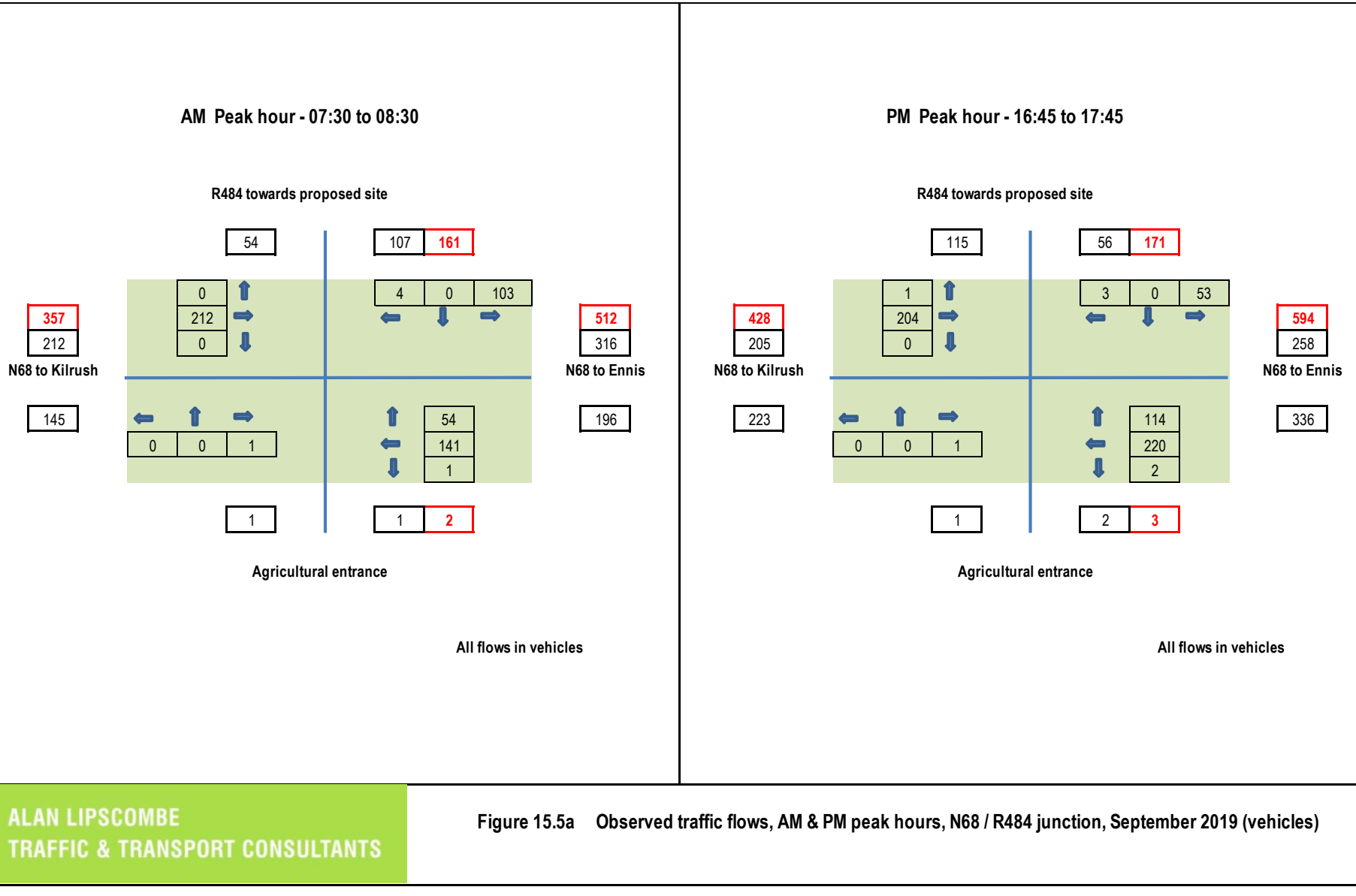


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Figure 15.5a Observed traffic flows, AM & PM peak hours, N68 / R484 junction, September 2019 (vehicles)

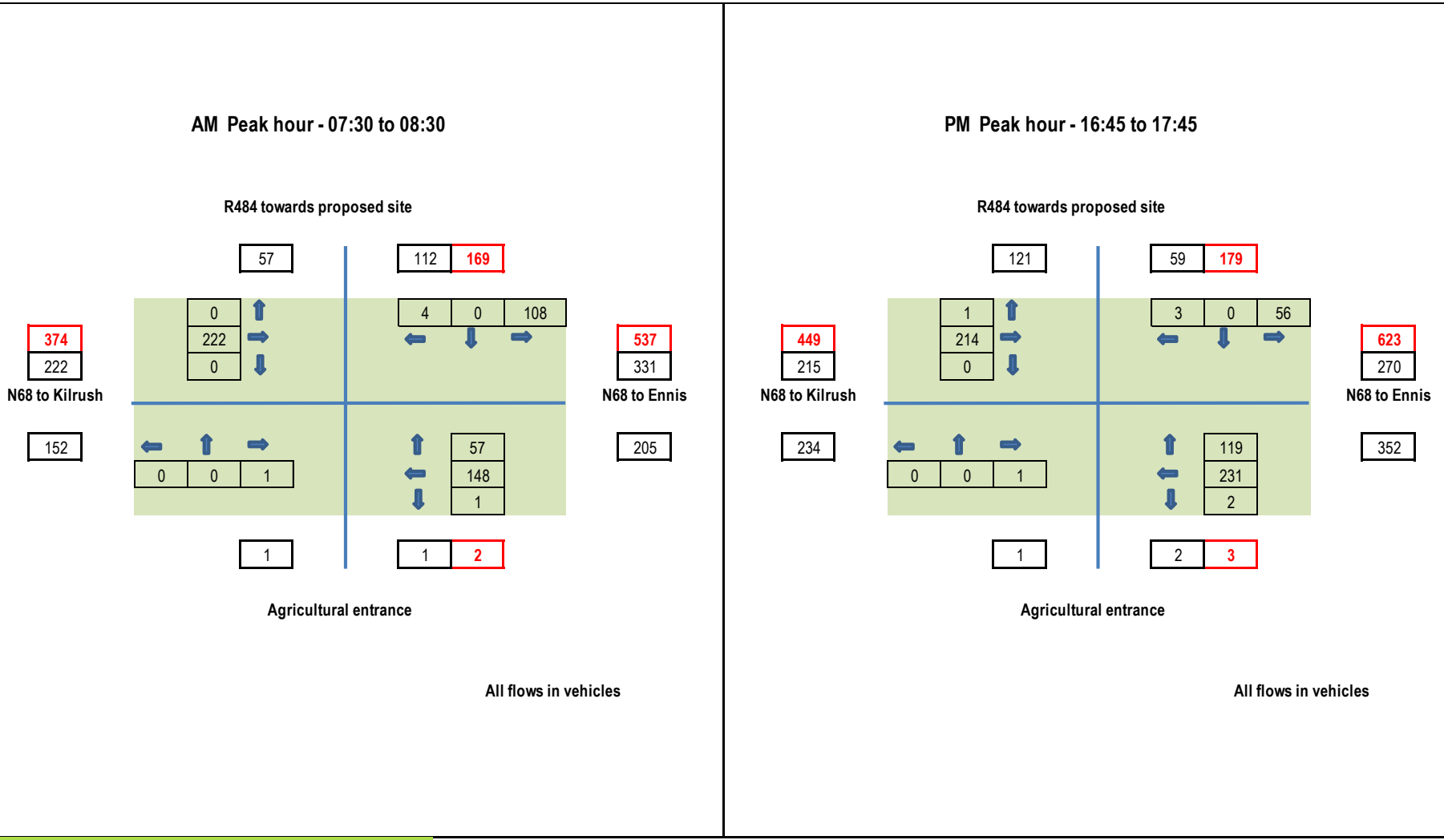

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Figure 15.5b Forecast background traffic flows, AM & PM peak hours, N68 / R484 junction, year 2024 (vehicles)

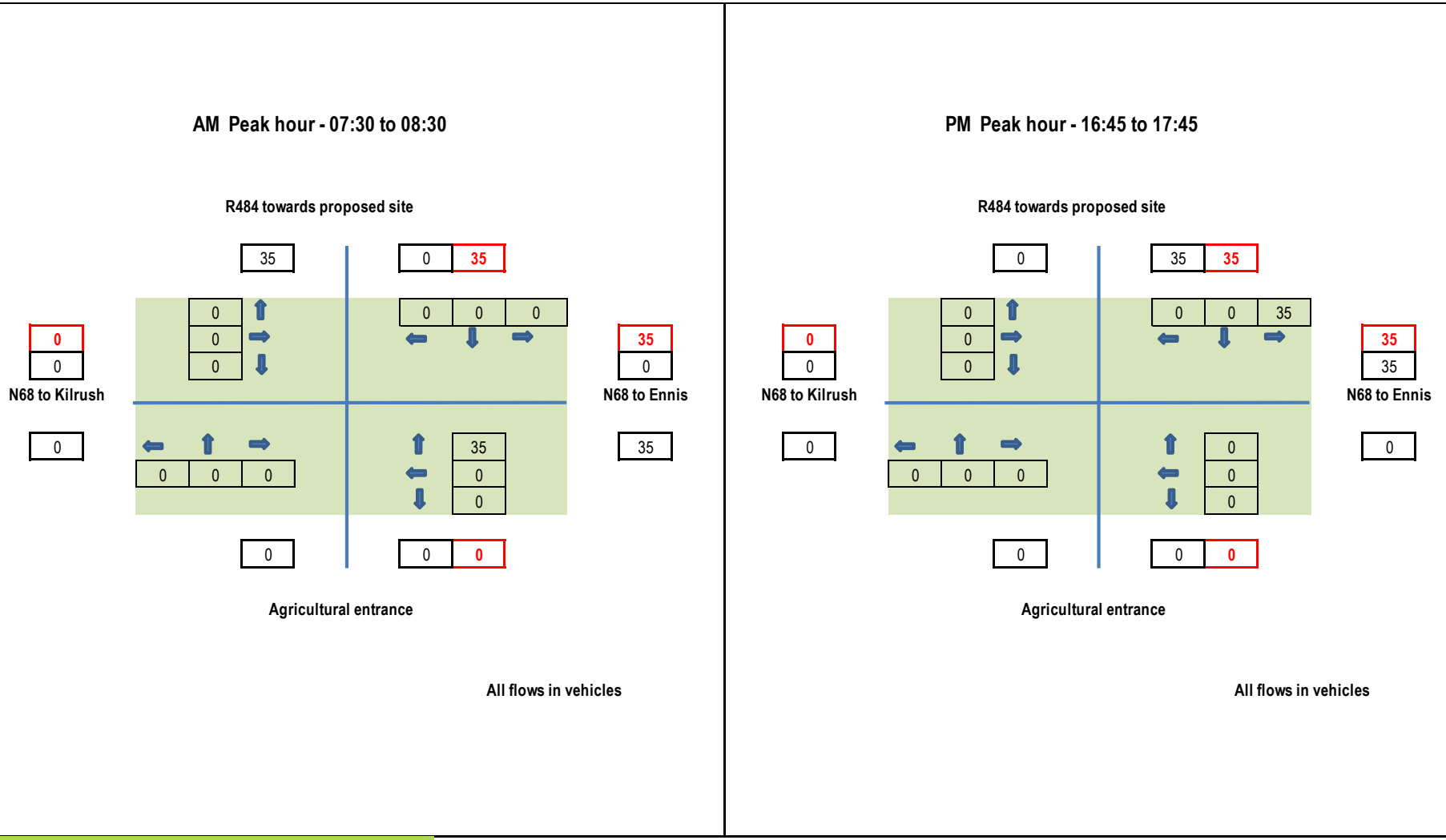

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Figure 15.5c Development generated traffic flows, AM & PM peak hours, N68 / R484 junction (vehicles)

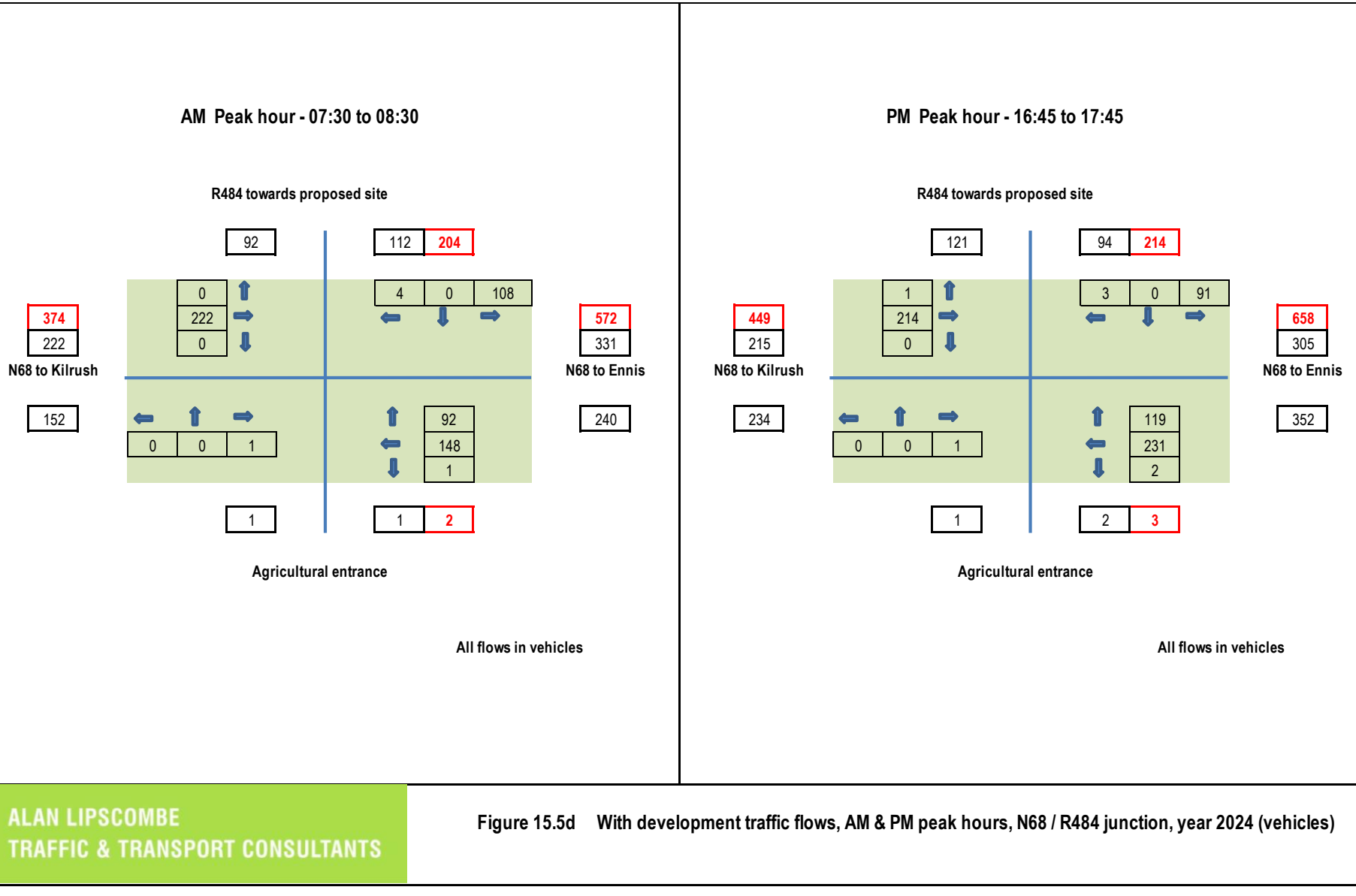

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Figure 15.5d With development traffic flows, AM & PM peak hours, N68 / R484 junction, year 2024 (vehicles)

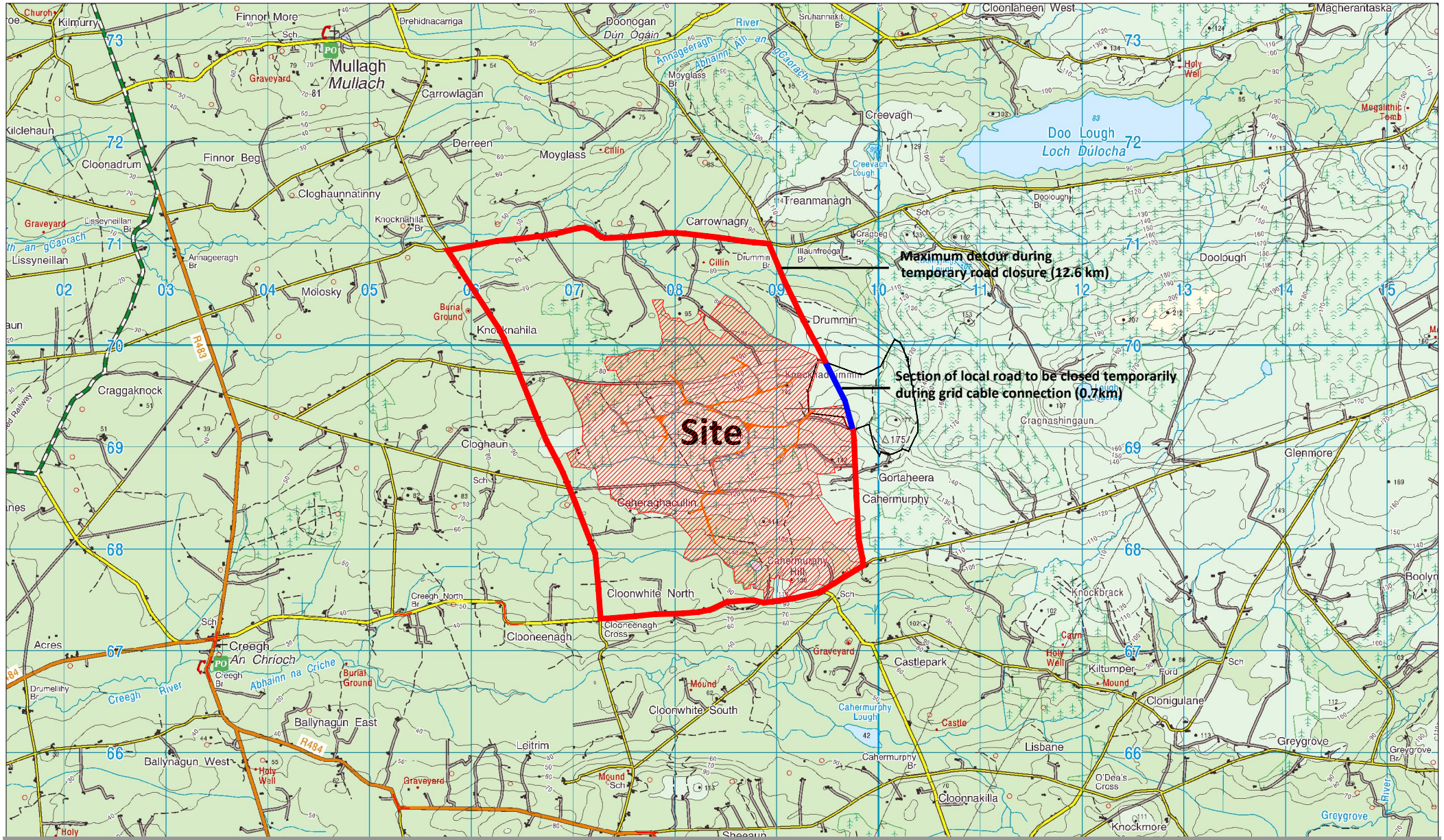

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Figure 15.6 Temporary road closure A and detour during grid cable construction

PROJECT:	Cahermurphy Wind Farm Extension		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte	SCALE:	NTS
PROJECT NO: 3770	DATE: 06.05.20	DRAWN BY:	AL

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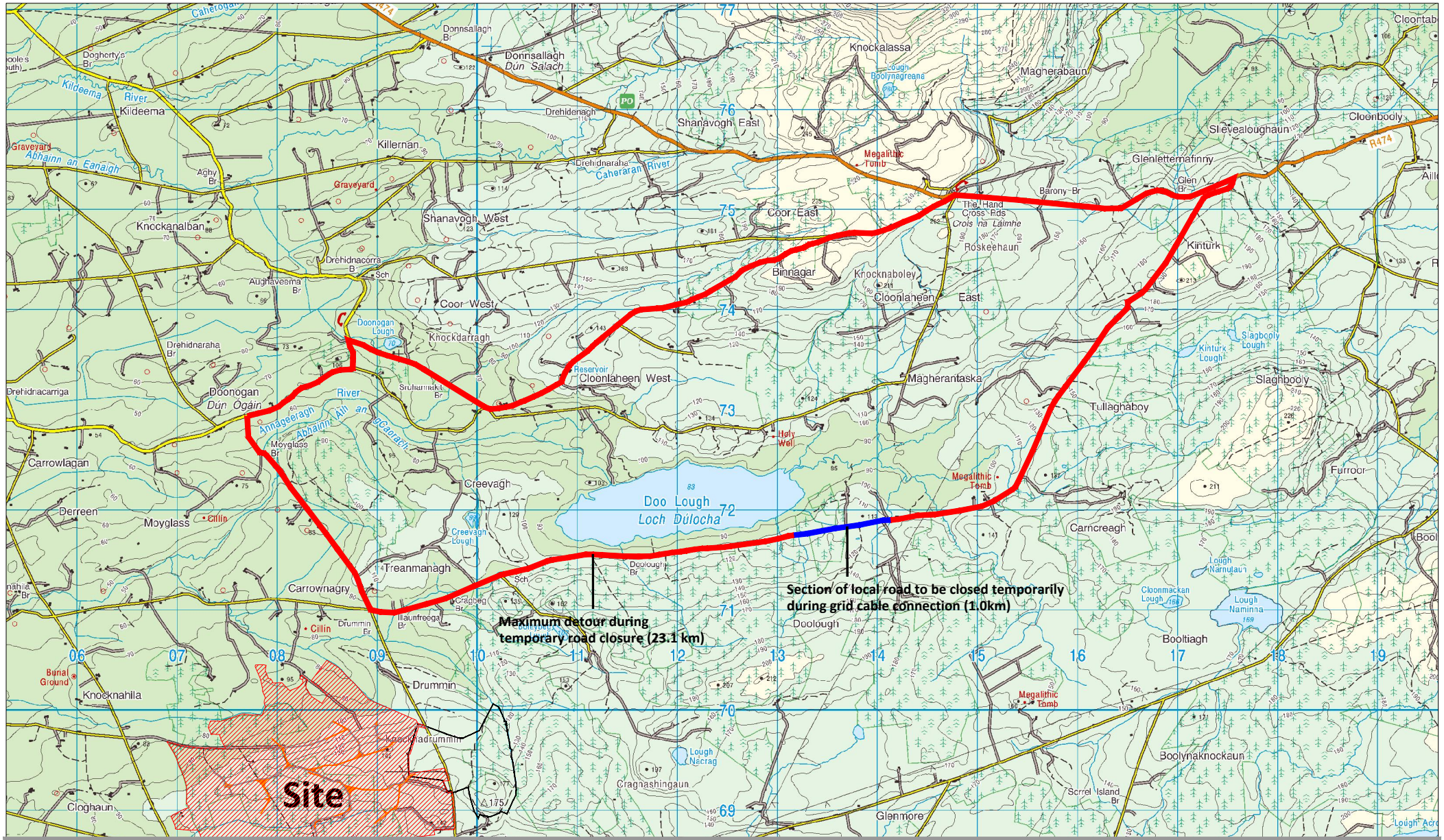

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Figure 15.7 Temporary road closure B and detour during grid cable construction

PROJECT:	Cahermurphy Wind Farm Extension		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte	SCALE:	NTS
PROJECT NO: 3770	DATE: 06.05.20	DRAWN BY:	AL

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15.1.7 Traffic Management of Large Deliveries

The greatest effect on the road network will likely be experienced on the approximately 30 days during which the 3 large loads comprising the tower sections, the blades and the nacelles are delivered to the site.

Traffic management measures are included in Section 15.1.10.6 and include the following:

- Identification of a delivery schedule,
- Details of the alterations required to the infrastructure identified in Section 15.1.8 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 local road widening. 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.

At a minimum, all of the deliveries comprising abnormally sized large loads will be made outside the normal peak traffic periods to avoid disruption to work and school related traffic.

15.1.8 Route Assessment

A preliminary route assessment indicated that, while certain pinch points would require a more detailed assessment, the optimum route to the site would be via the N68 to Ballyduneen, the R484 to Creegh and the local network to the site. This route, which is indicated in Figure 15.2a, was therefore selected as the transport route and all following discussion in this section refers to the route in the direction that vehicles accessing the site will travel.

All locations along the route referred to in this section are highlighted in Figure 15.2a. While commentary is provided for additional locations along the route the detailed assessment is confined to locations considered as potentially presenting issues for the abnormal loads, as identified from site visits.

For these locations preliminary road and junction alignments, based on OS mapping or site surveys, were used for the assessment. A preliminary swept path analysis was then undertaken using Autotrack in order to establish the locations where the wind farm transporter vehicles will be accommodated, and the locations where some form of remedial measure may be required. As is industry best practice, a dry run of the route and condition surveys of roads and bridges will be completed at that time.

The locations discussed are as follows;

- Location 1 - N68 / R484 junction at Ballyduneen
- Location 2 – Double bend at Sheeauh
- Location 3 – Right turn at graveyard
- Location 4 – Bridge over River Creegh

- Location 5 – Right turn through Creegh
- Location 6 – Bridge at Creegh North
- Location 7 – Double bend at Clooneenagh
- Location 8 – Bend west of Cahermurphy hill
- Location 9 – Triangle near school
- Location 10 – Left turn up to site
- Location 11 – Access junction serving site

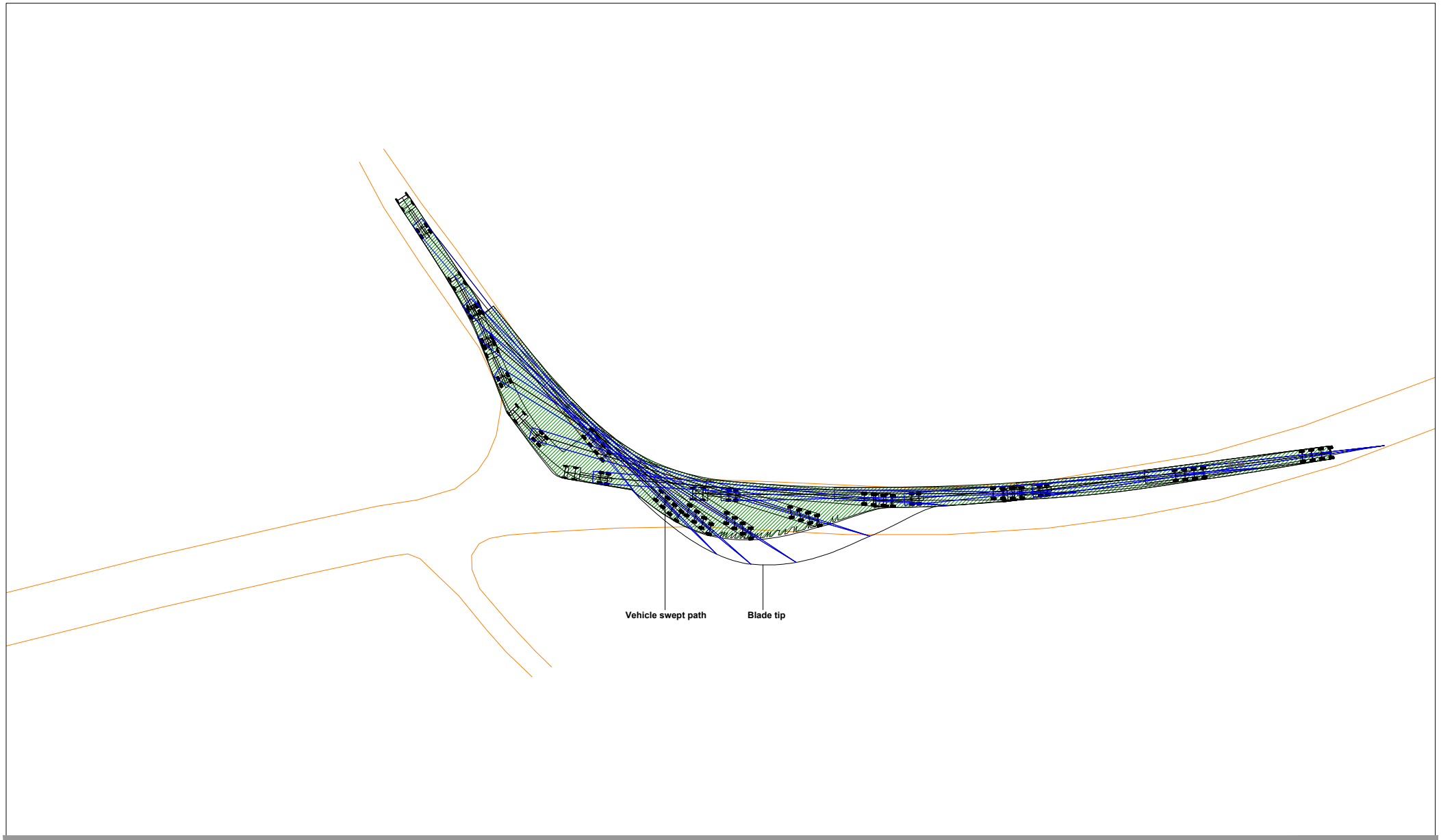
15.1.8.1 Access to the Wind Farm site via N68, R484 and local road network

Location 1 – N68 / R484 junction at Ballyduneen

The junction between the N68 and the R484 takes the form of a priority junction with the N68 comprising the major arm. The swept path assessment for the design vehicles negotiating the junction are shown in Figure 15-8 and Figure 15-9 for the blade and tower sections respectively. The figures show that both vehicles will be accommodated with some minor temporary local widening of the carriageway and temporary relocation of of some signs, street furniture and overhead cables.

The R484 between the junction and Kilmihil is a standard two lane road of relatively good quality with no significant bends or dips.

Plate 15-1 Location 1 – N68 / R484 junction at Ballyduneen, looking west along N68



NOTES:

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Figure 15.8 Location 1 - N68 / R484 junction at Ballyduneen, blade extended artic (68.5m blade)

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte		SCALE: 1:1000
PROJECT NO: 3770	DATE: 11.08.20		DRAWN BY: AL

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Figure 15.9 Location 1 - N68 / R484 junction at Ballyduneen, tower extended artic

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte		SCALE: 1:1000
PROJECT NO: 3770	DATE: 11.08.20		DRAWN BY: AL

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Plate 15-2 Location 1 – N68 / R484 junction at Ballyduneen, looking east along N68

Plate 15-3 Location 1 – N68 / R484 junction at Ballyduneen, looking north along R484

Plate 15-4 R484 between Ballyduneen and Kilmihil

Plate 15-5 R484 south of Kilmihil

Location 2 – Double bend at Sheeauh

This location is tight and there will likely be the need for some minor temporary carriageway widening at the locations shown in Figure 15-10 and Figure 15-11.

Location 3 – Right turn at graveyard

The geometry at this location is tight and the autotrack assessment shown in Figure 15-12 and Figure 15-13 indicates that minor temporary local widening of the road will be required to the south in order to accommodate the extended wind turbine vehicles.

Plate 15-6 Location 4 – looking north over bridge R484

Location 4 – Bridge over River Creegh

The autotracks assessment set out in Figure 15-14 and Figure 15-15 indicate that minor temporary local widening will be required at this location.

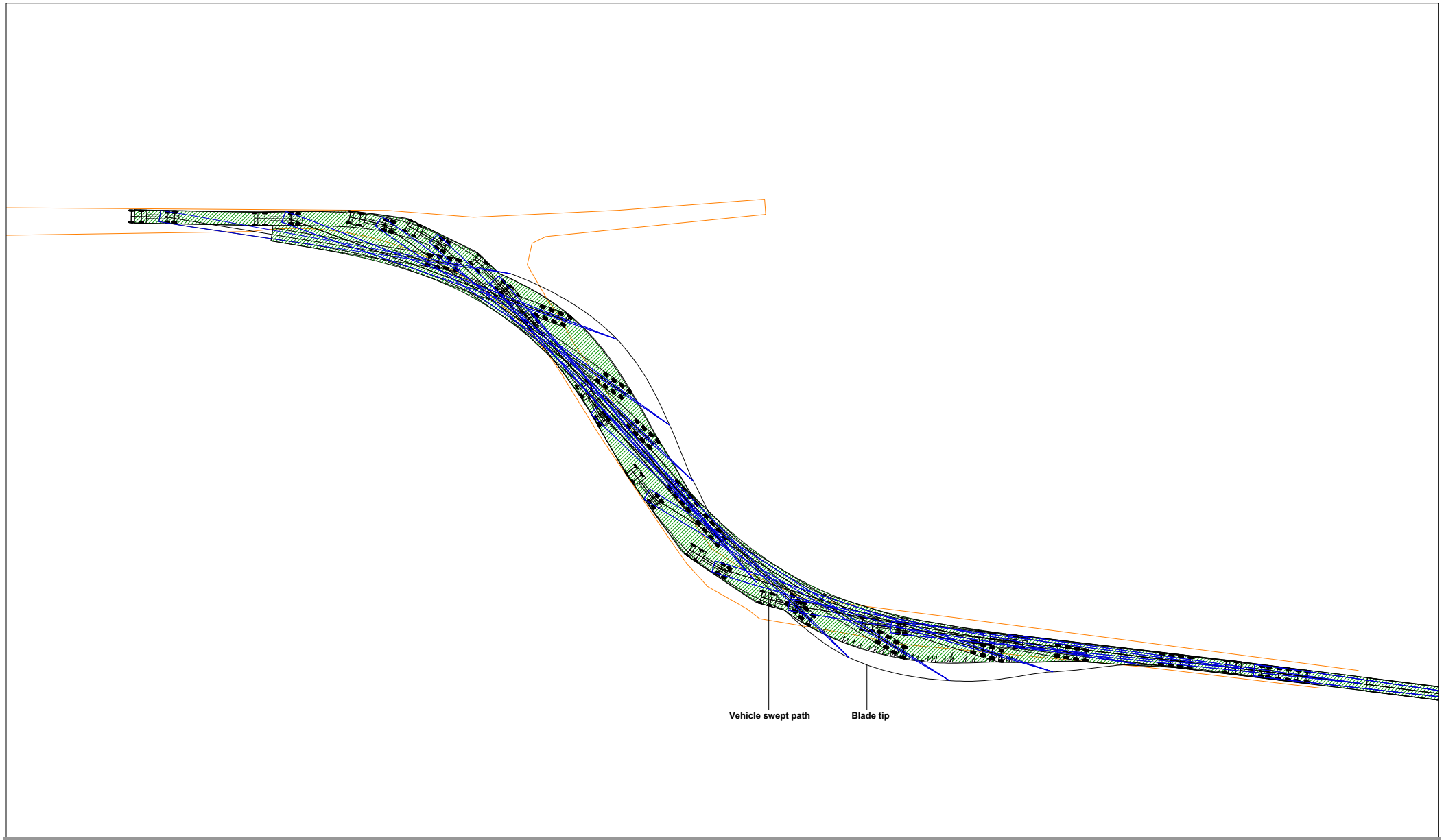

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Figure 15.10 Location 2 - Double bend at Sheeauh, blade extended artic (68.5m blade)

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte		SCALE: 1:1000
PROJECT NO: 3770	DATE: 11.08.20		DRAWN BY: AL

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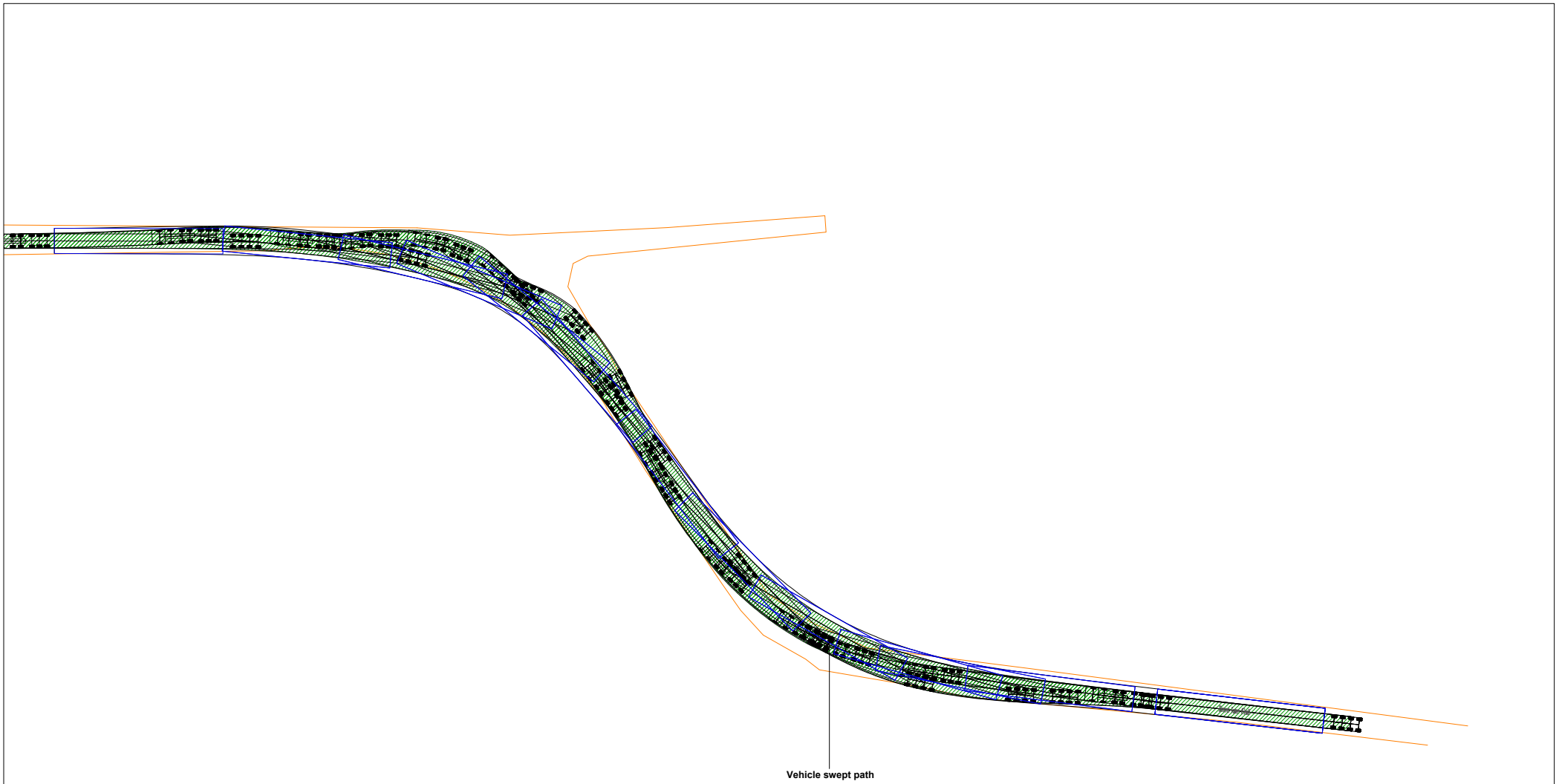

NOTES:

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Figure 15.11 Location 2 - Double bend at Sheeauh, tower extended artic

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte	SCALE:	1:1000
PROJECT NO: 3770	DATE: 11.08.20	DRAWN BY:	AL

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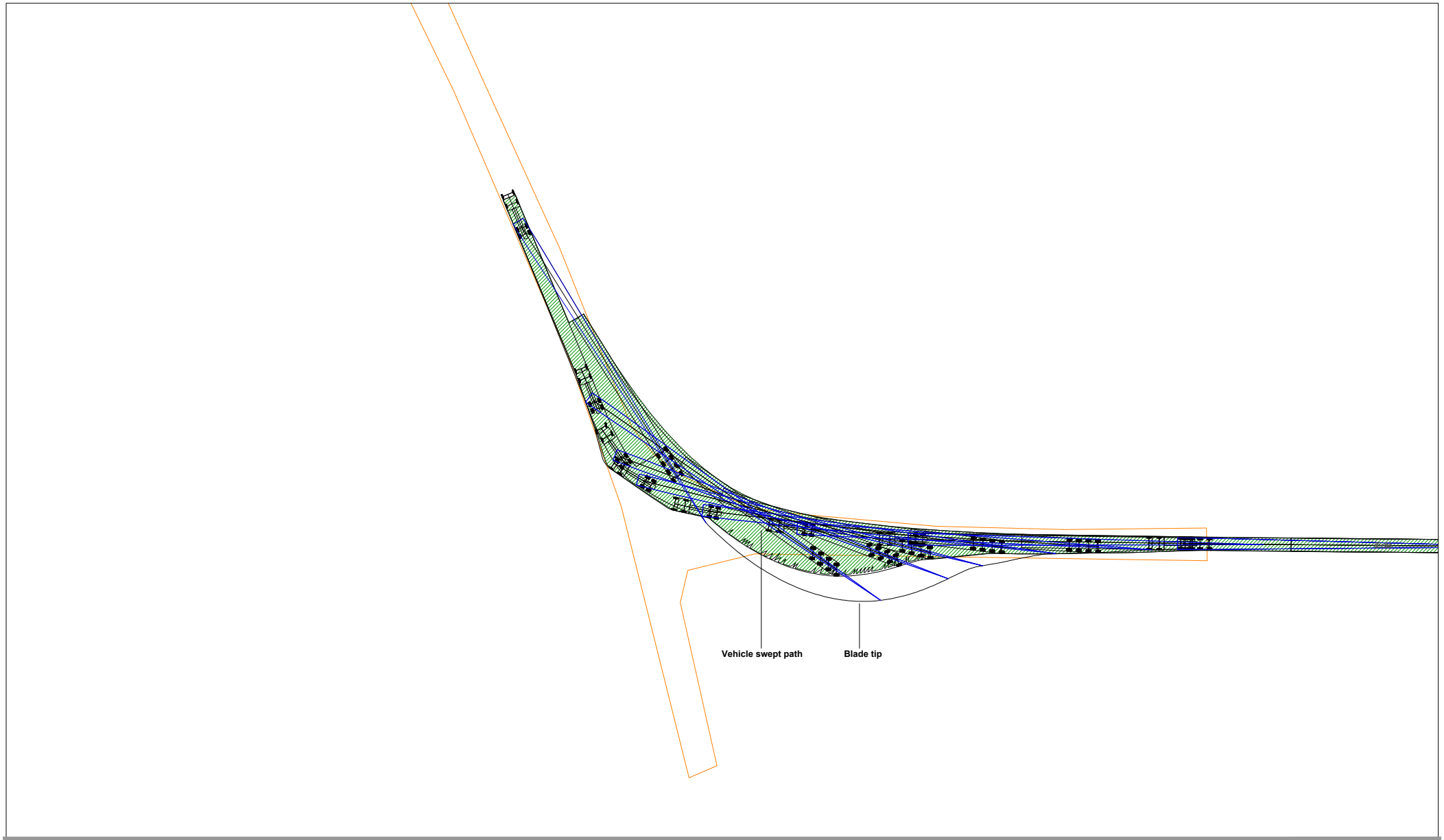

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Figure 15.12 Location 3 - Right turn at graveyard, blade extended artic (68.5m blade)

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte		SCALE: 1:1000
PROJECT NO: 3770	DATE: 11.08.20		DRAWN BY: AL

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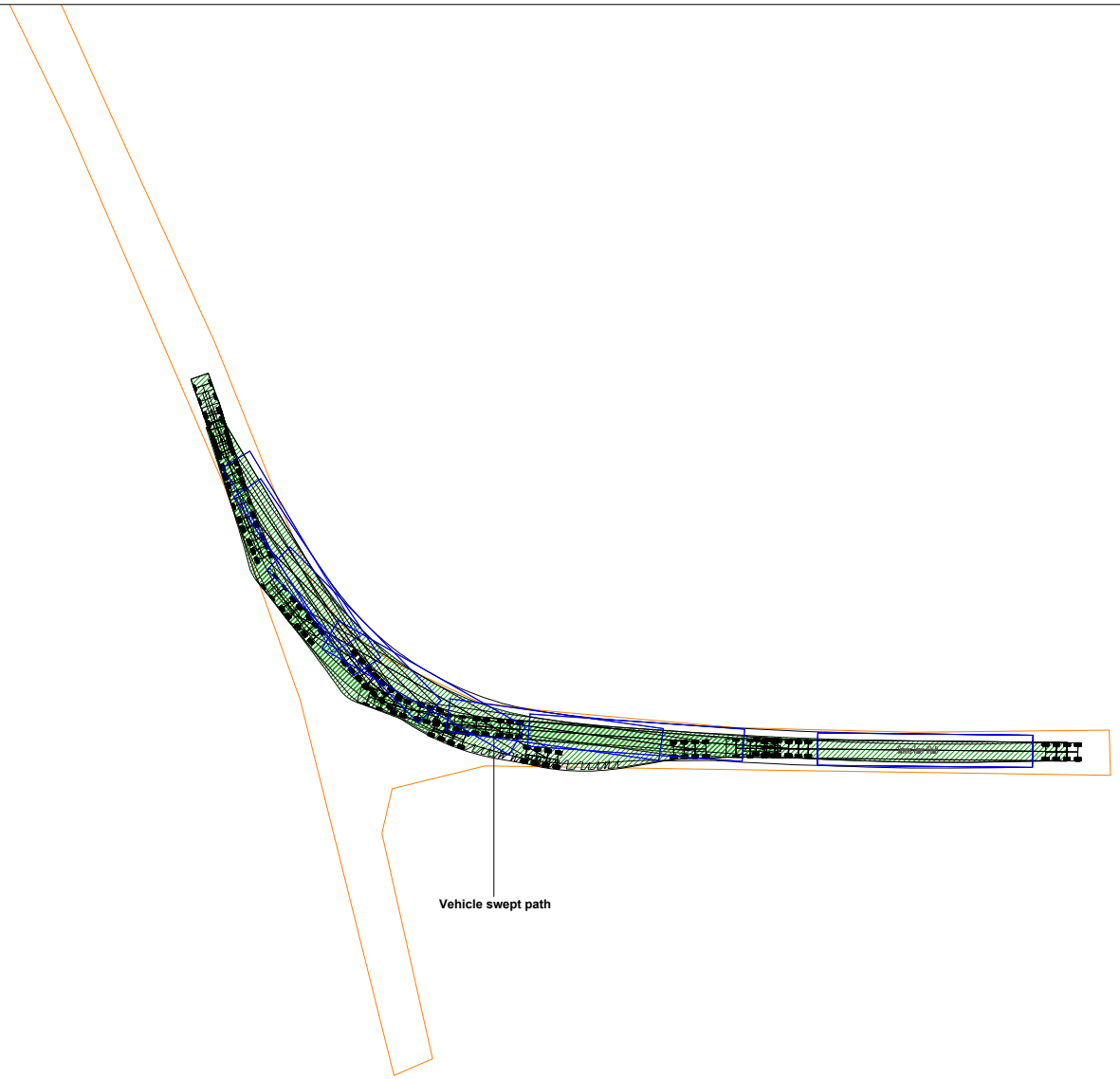

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Figure 15.13 Location 3 - Right turn at graveyard, tower extended artic

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte		SCALE: 1:1000
PROJECT NO: 3770	DATE: 11.08.20		DRAWN BY: AL

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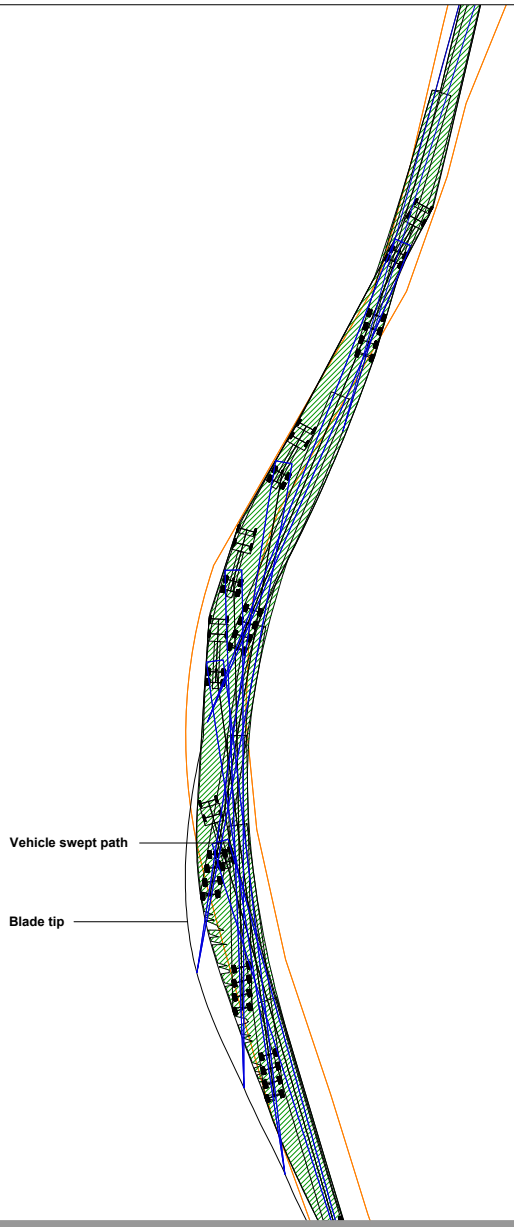

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Figure 15.14 Location 4 - Bridge over River Creegh, blade extended artic (68.5m blade)

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte		SCALE: 1:1000
PROJECT NO: 3770	DATE: 11.08.20		DRAWN BY: AL

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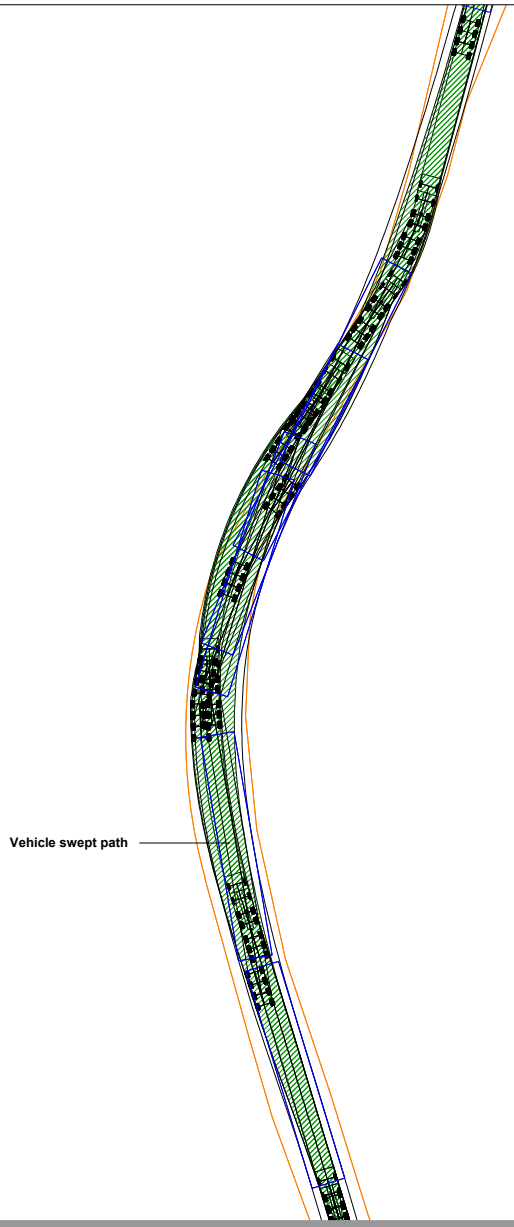

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Figure 15.15 Location 4 - Bridge over River Creegh, tower extended artic

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte		SCALE: 1:1000
PROJECT NO: 3770	DATE: 11.08.20		DRAWN BY: AL

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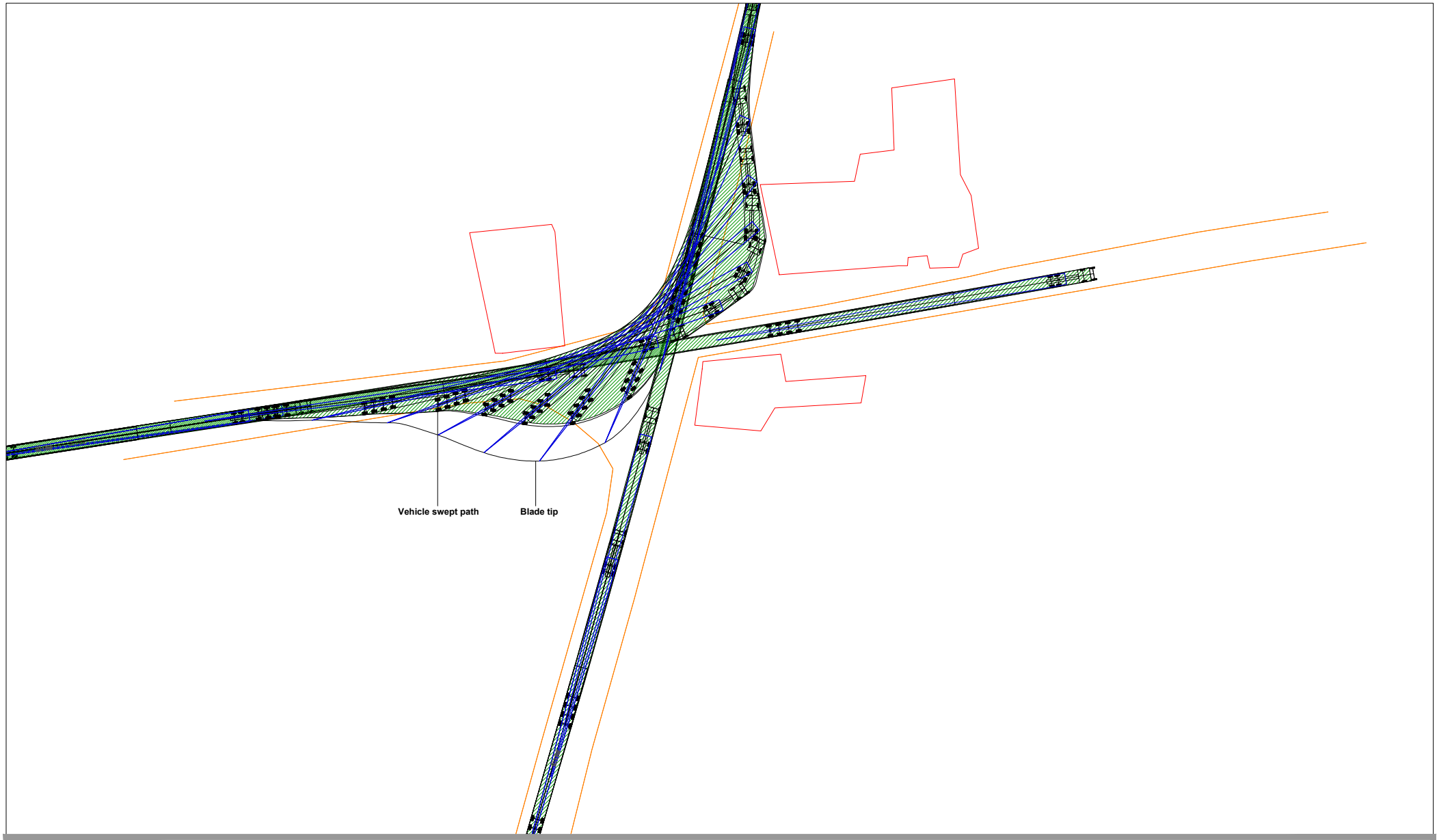
Plate 15-7 Location 5 – Right turn through Creegh

Location 5 – Right turn through Creegh

While it is intended that the extended turbine vehicles will make a 3-point manoeuvre at this location in order to minimise the impact on existing property boundaries, the swept path analysis shown in Figure 15-16 and Figure 15-17 suggests that there will be a minor temporary widening south west of the junction. It is also noted that some sign posts require to be removed temporarily.



NOTES:

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Figure 15.16 Location 5 - Right turn through Creegh, blade extended artic (68.5m blade)

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte		SCALE: 1:1000
PROJECT NO: 3770	DATE: 11.08.20		DRAWN BY: AL

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Figure 15.17 Location 5 - Right turn through Creegh, tower extended artic

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte	SCALE:	1:1000
PROJECT NO: 3770	DATE: 11.08.20	DRAWN BY:	AL

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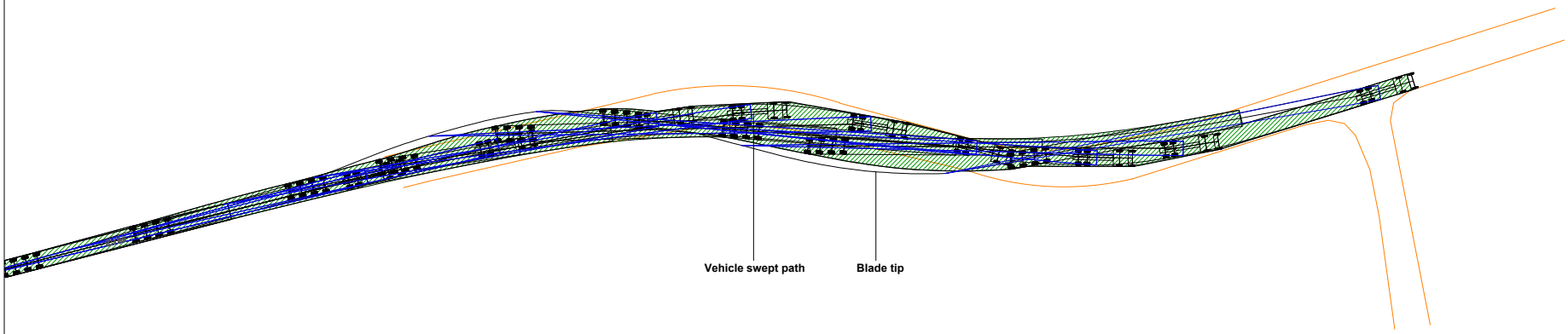
Plate 15-8 Location 6 – Looking east over bridge

Location 6 – Bridge at Creegh North

As per location 4 the figures suggest that this bridge is tight (see Figure 15-18 and Figure 15-19). The preliminary assessment indicated that minor temporary widening will be required at this location.



NOTES:

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Figure 15.18 Location 6 - Bend at Creegh North, blade extended artic (68.5m blade)

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte		SCALE: 1:1000
PROJECT NO: 3770	DATE: 11.08.20		DRAWN BY: AL

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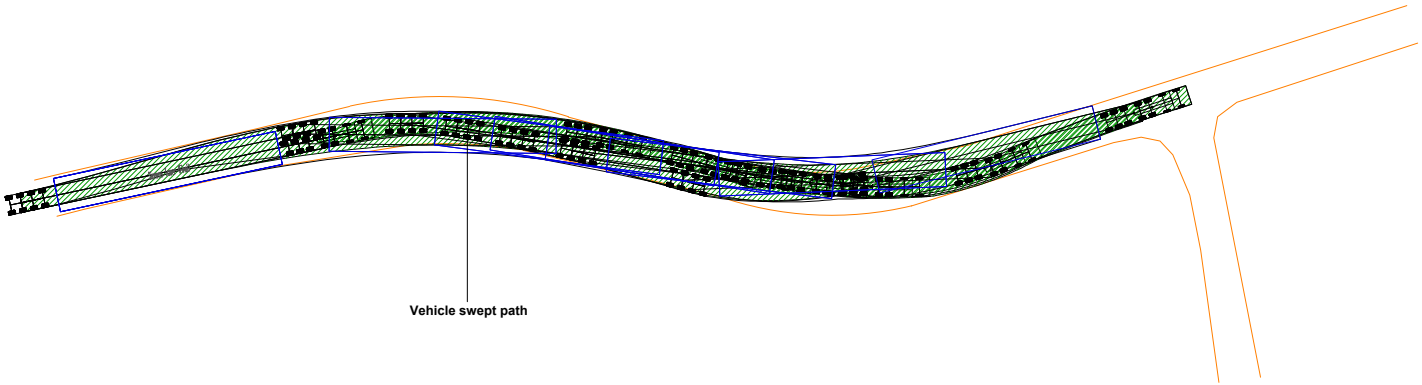

NOTES:

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Figure 15.19 Location 6 - Bend at Creegh North, tower extended artic

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte		SCALE: 1:1000
PROJECT NO: 3770	DATE: 11.08.20		DRAWN BY: AL

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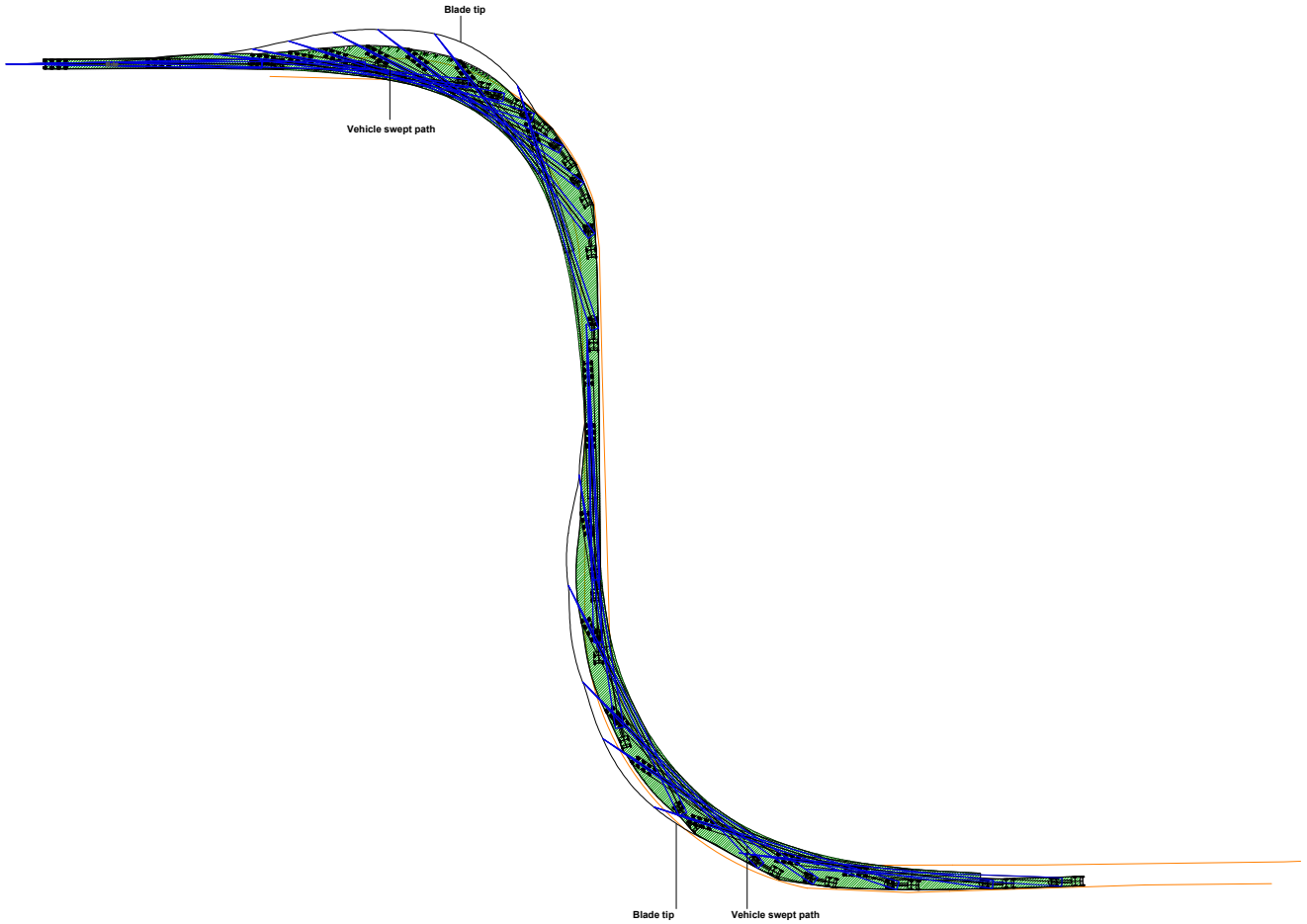
Plate 15-9 Location 7 – Looking East at Northern Bend

Location 7 – Double bend at Clooneenagh

The preliminary assessment shown in Figure 15-20 and Figure 15-21 indicated that local carriageway minor carriageway widening will be required at this S-bend.



NOTES:

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Figure 15.20 Location 7 - Double bend at Clooneenagh, blade extended artic (68.5m blade)

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte		SCALE: 1:2000
PROJECT NO: 3770	DATE: 11.08.20		DRAWN BY: AL

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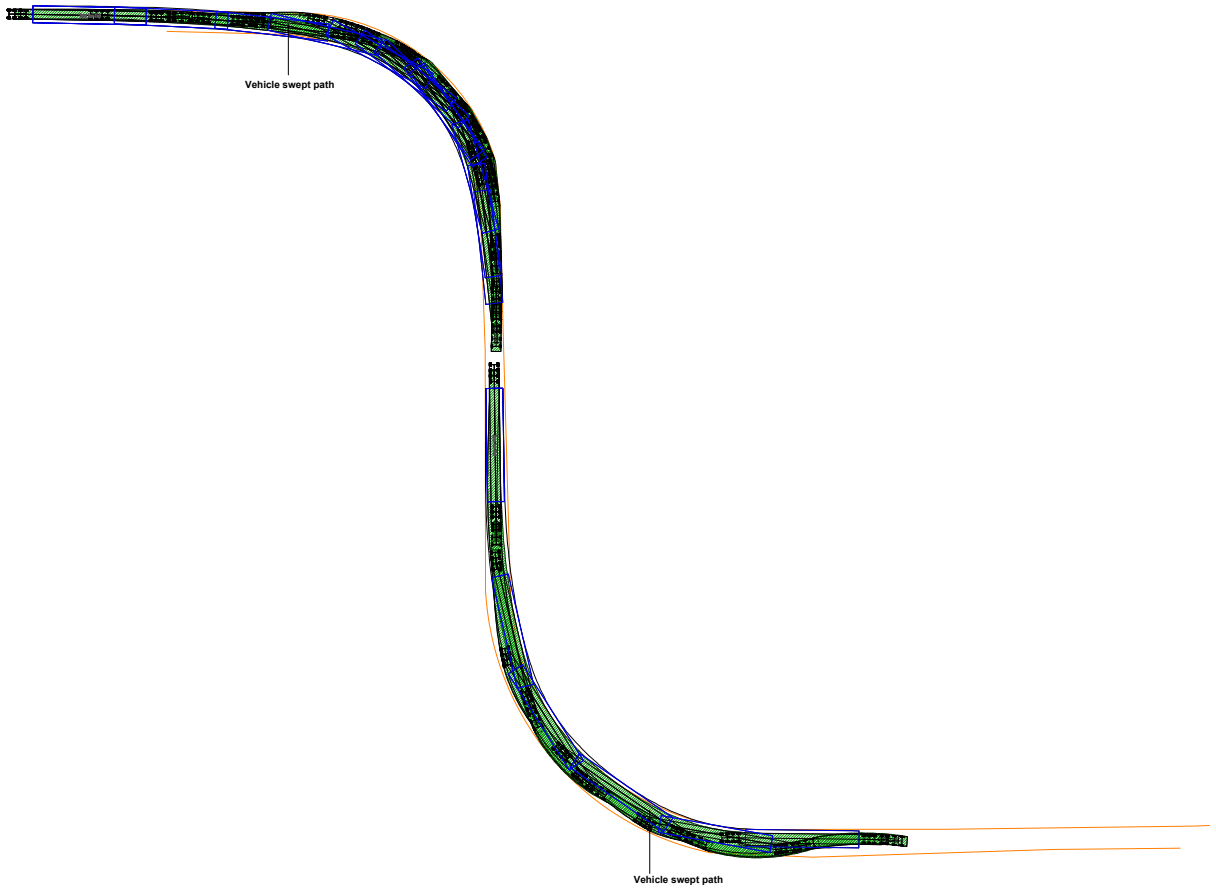

NOTES:

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Figure 15.21 Location 7 - Double bend at Clooneenagh, tower extended artic

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte		SCALE: 1:2000
PROJECT NO: 3770	DATE: 11.08.20		DRAWN BY: AL

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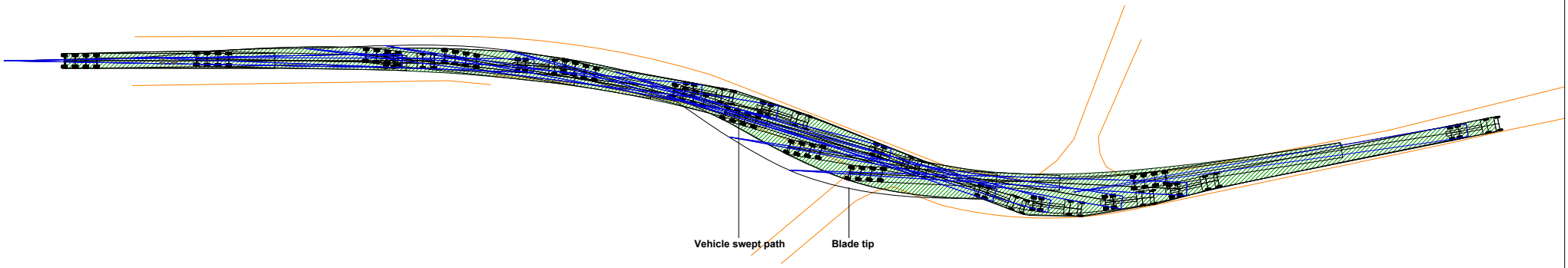
Plate 15-10 Location 7 – looking south at Southern bend

Location 8 – Bend west of Cahermurphy Hill

The autotrack assessment for this location, shown in Figure 15-22 and Figure 15-23, suggests that the wind turbine vehicles will require minor temporary local road widening in order to be accommodated at this location.

Location 9 - Triangle near school

While the autotrack assessment suggest this location should accommodate the delivery vehicles, a dry run is recommended prior to the delivery stage due to transverse gradient at this location (see Figure 15-24 and Figure 15-25).



NOTES:

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Figure 15.22 Location 8 - Bend west of Cahermurphy Hill, blade extended artic (68.5m blade)

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte	SCALE:	1:1000
PROJECT NO: 3770	DATE: 11.08.20	DRAWN BY:	AL

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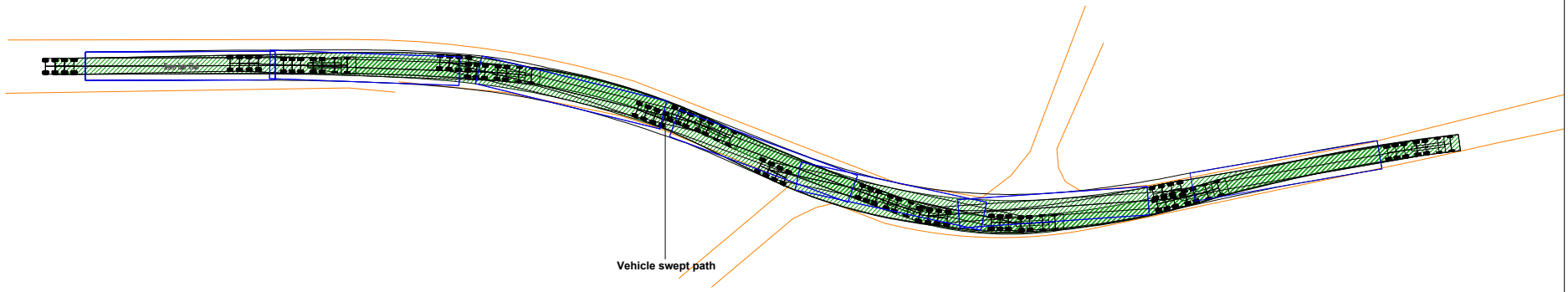

NOTES:

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Figure 15.23 Location 8 - Bend west of Cahermurphy Hill, tower extended artic

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte		SCALE: 1:1000
PROJECT NO: 3770	DATE: 11.08.20		DRAWN BY: AL

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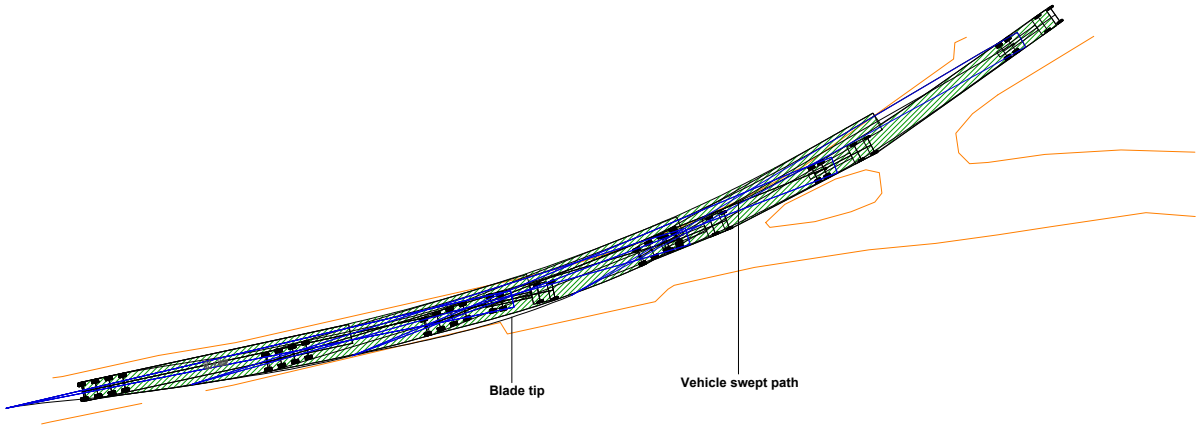

NOTES:

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Figure 15.24 Location 9 - Triangle near school, blade extended artic (68.5m blade)

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte		SCALE: 1:1000
PROJECT NO: 3770	DATE: 11.08.20		DRAWN BY: AL

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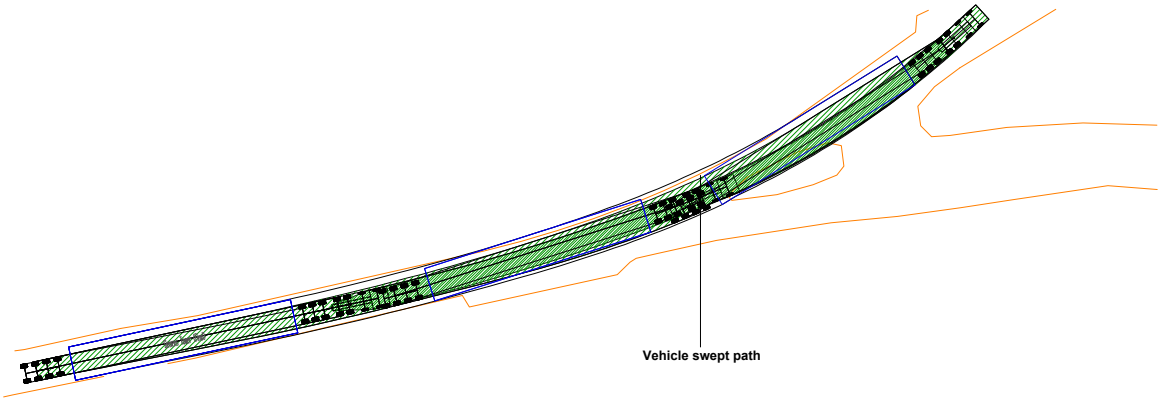

NOTES:

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Figure 15.25 Location 9 - Triangle near school, tower extended artic

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte		SCALE: 1:1000
PROJECT NO: 3770	DATE: 11.08.20		DRAWN BY: AL

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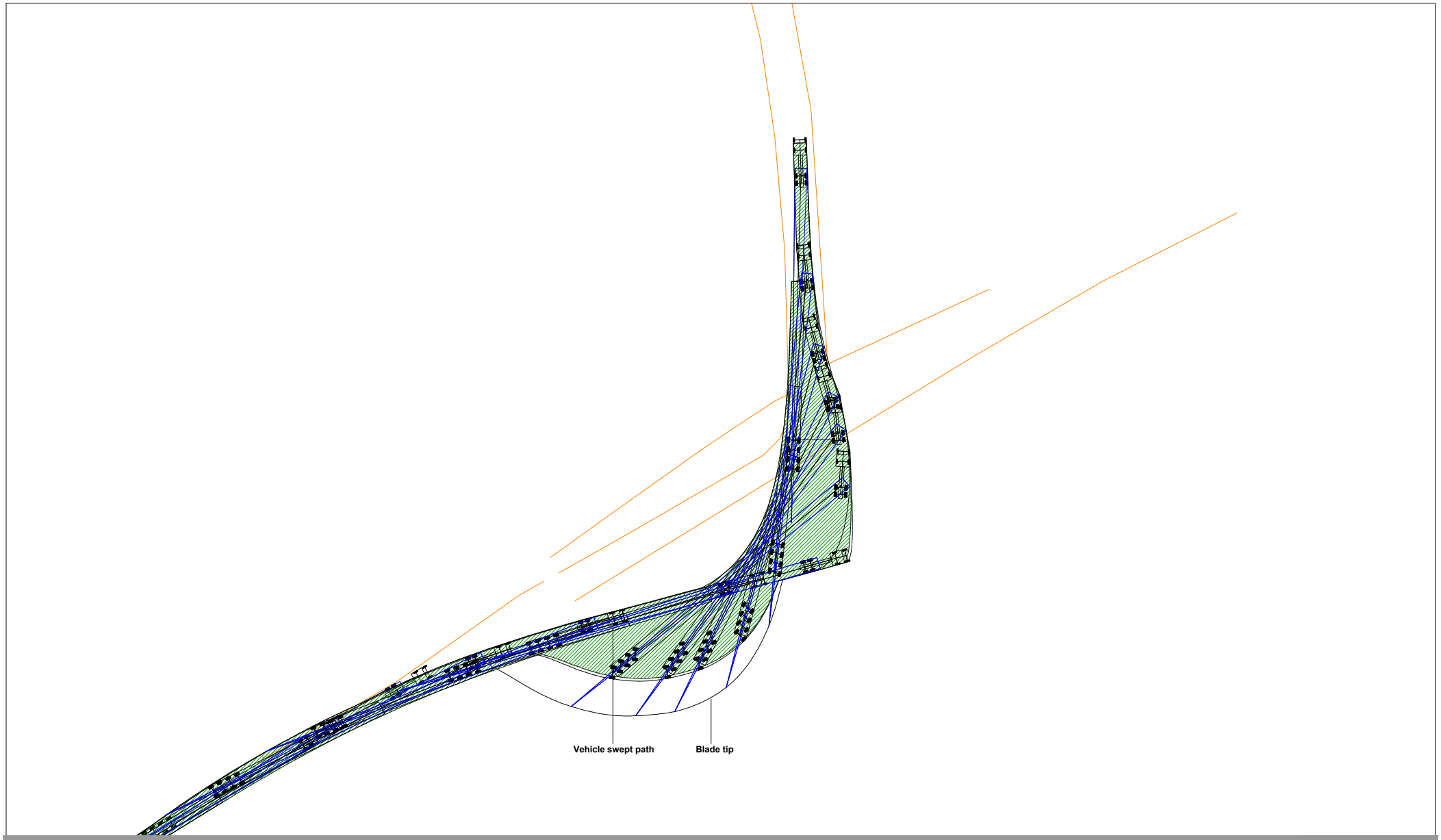


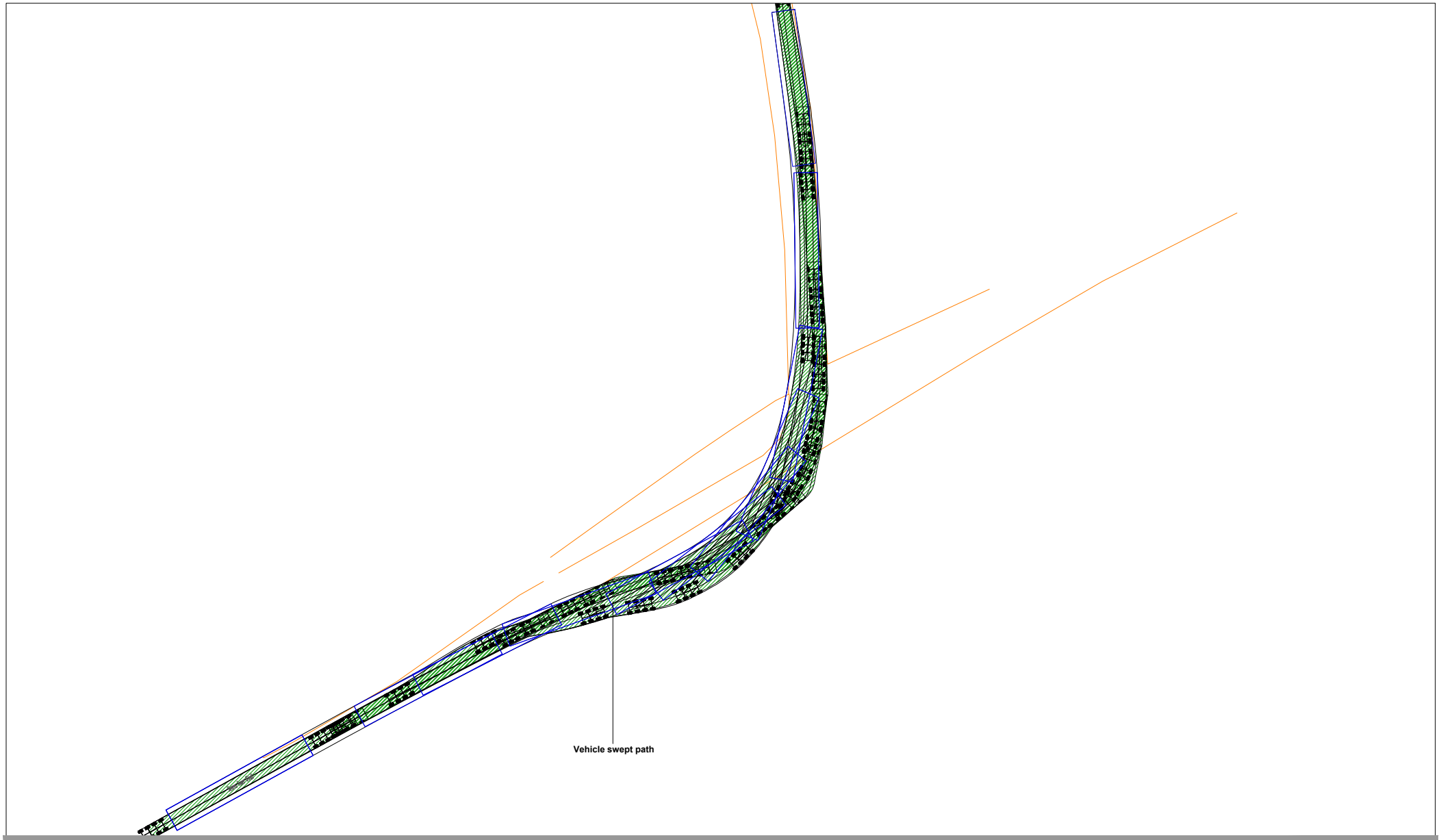
NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Figure 15.26 Location 10 - Left turn up to site, blade extended artic (68.5m blade)

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte		SCALE: 1:1000
PROJECT NO: 3770	DATE: 11.08.20		DRAWN BY: AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS



NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Figure 15.27 Location 10 - Left turn up to site, tower extended artic

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy DAC & Coillte	SCALE:	1:1000
PROJECT NO: 3770	DATE: 11.08.20	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS

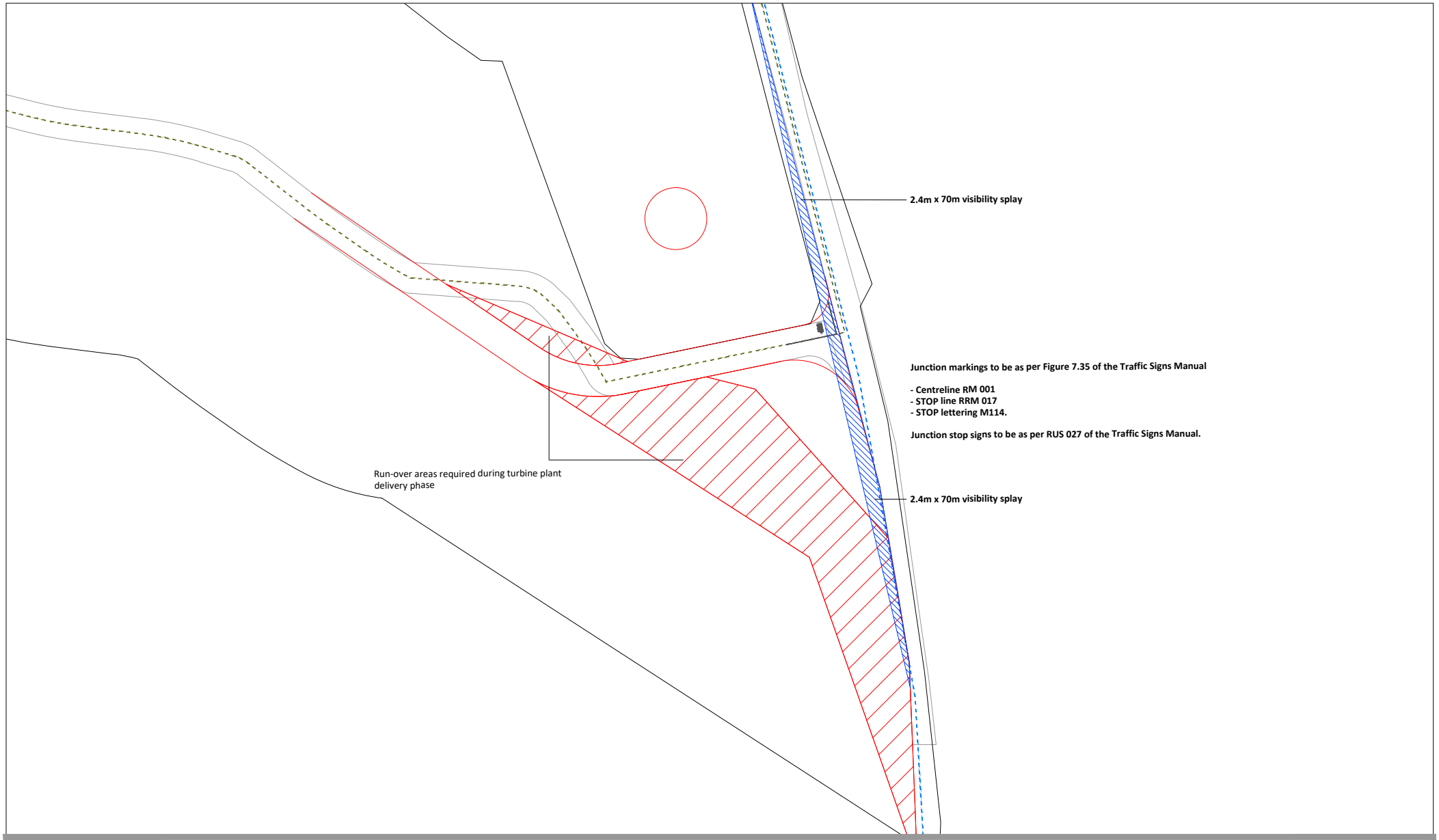
Plate 15-11 Location 9 – Looking east through triangle

Location 10 – Left turn up to site

The swept path assessment for this location, shown in Figure 15-26 and Figure 15-27, indicated that minor carriageway widening will be required to the south of the existing road in order to accommodate the wind turbine vehicles. It is noted that there has already been some local widening to accommodate a neighbouring wind farm currently under construction.

Plate 15-12 Location 10 – Left turn up towards site

Plate 15-13 looking north towards site access



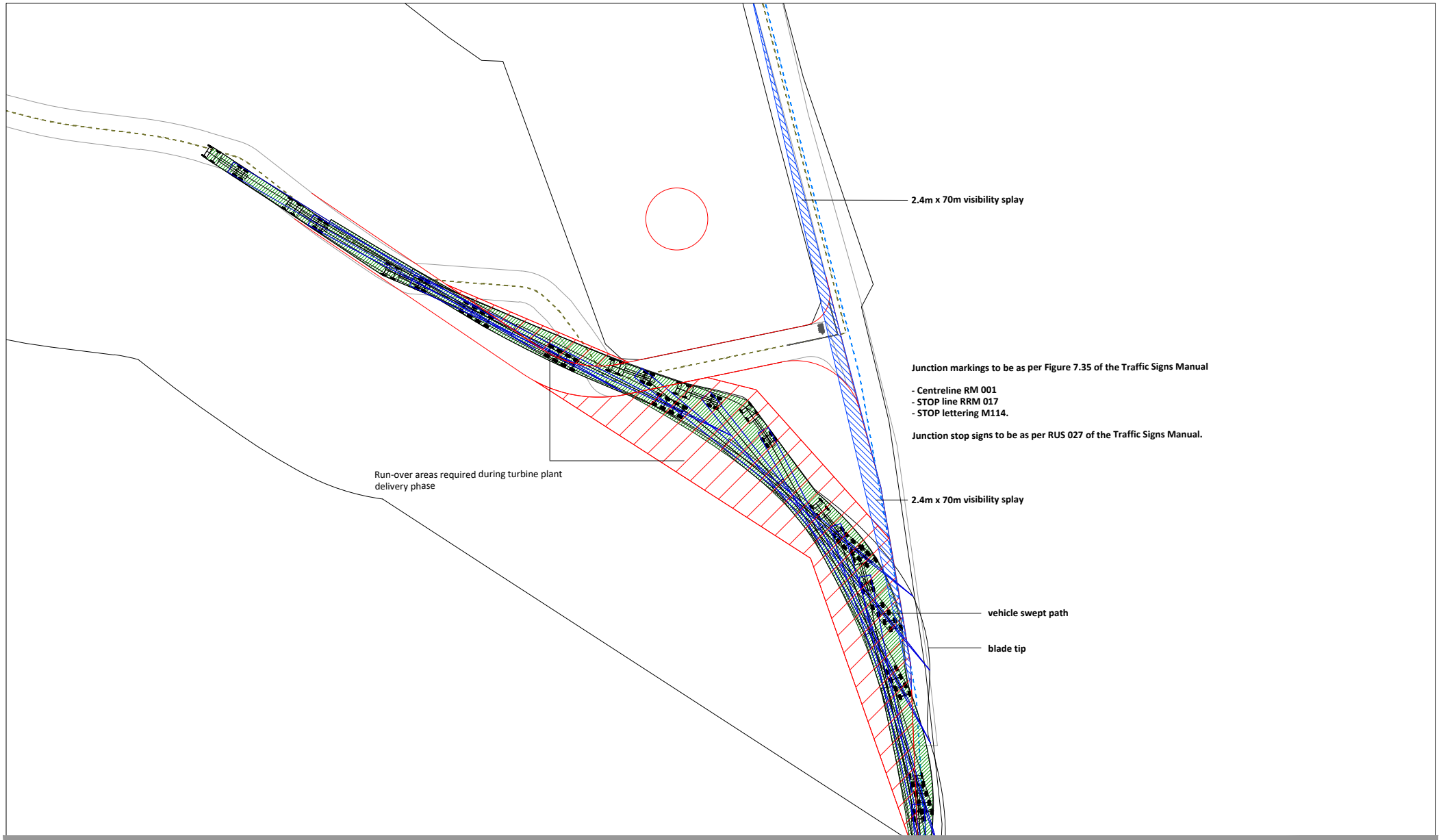
NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Figure 15.28 Location 11 - Proposed site access

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy Ltd & Coillte		SCALE: 1:1000
PROJECT NO: 3770	DATE: 06.05.20		DRAWN BY: AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS



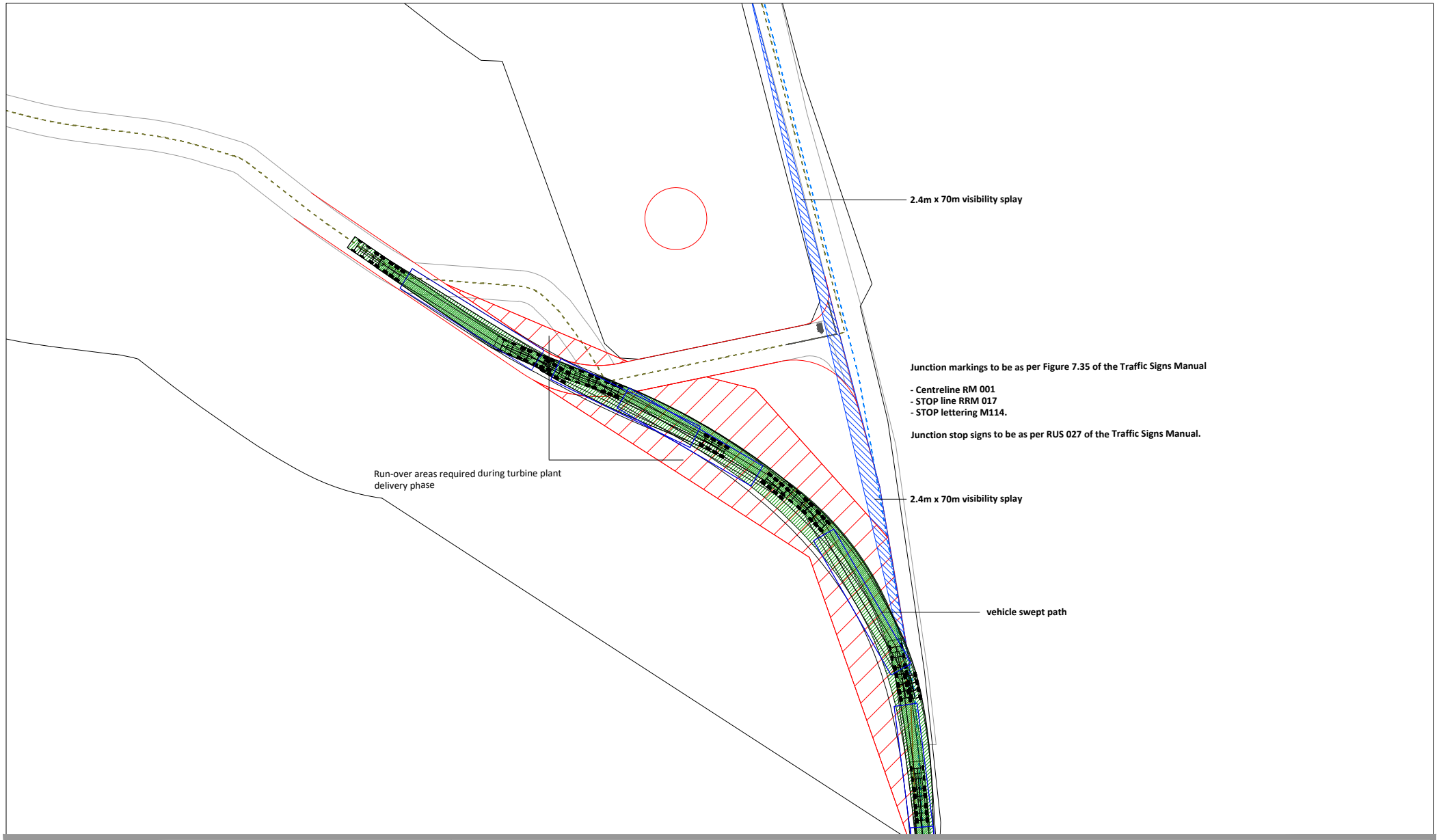
NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Figure 15.29 Location 11 - Proposed site access, blade extended artic

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy Ltd & Coillte		SCALE: 1:1000
PROJECT NO: 3770	DATE: 11.08.20		DRAWN BY: AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS



NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Figure 15.30 Location 11 - Proposed site access, tower extended artic

PROJECT:	Cahermurphy Wind Farm EIAR		
CLIENT:	Mid Clare Renewable Energy Ltd & Coillte		SCALE: 1:1000
PROJECT NO: 3770	DATE: 11.08.20		DRAWN BY: AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS

Location 11 – Sight access junctions

The temporary works required to accommodate the wind farm turbine vehicles, together with the junction layout proposed on completion are shown for the proposed access junction in Figure 15-28 to Figure 15-30. The figures confirm that the temporary junction layout proposed for the construction stage will accommodate all wind farm transport vehicles. The 70m visibility splays are indicated in plan on Figure 15-28.

15.1.9 Provision for Sustainable Modes of Travel

15.1.9.1 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.

15.1.9.2 Public Transport

There are no public transport services that currently pass the site although mini-buses may be considered for transporting staff to and from the site in order to minimise traffic generation and parking demand on site.

15.1.10 Likely and Significant Effects and Associated Mitigation Measures

15.1.10.1 "Do Nothing" Scenario

If the Proposed Development 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.

15.1.10.2 Construction Phase

During the 10 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 6.1% on the N68 to an increase of 21.1% on the R484 leading to the site. As Castlepark Road currently provides for low traffic volumes, on these 10 days of the construction phase, flows are forecast to increase by almost 3 fold (186.8%). The effect will be temporary, lasting for 10 days, and will be slight to moderate.

During the remaining 245 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 1.3% on the N68, to an increase of 4.6% on the R484 approaching the site. On the Castlepark Road it is forecast that traffic flows will increase by 40.4%. The effect will be temporary, lasting for 245 days, and will be slight.

During the 10 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 0.9% on the N68, to an increase of 26.1 on the local Castlepark Road leading to the site. The effect during this period will be temporary and will be slight.

During the 30 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 1.5% on the N68 to 17.2% on Creegh Road and 19.6% on Castlepark Road leading to the site, but will be temporary. The 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 and the key junction on the delivery route between the N68 / R484 will operate within operational capacity for all days within the construction period.

15.1.10.3 Operational Phase

During the operational phase the effect on the surrounding local highway network will be negative and long term, but will be imperceptible given that there will be approx. 2 maintenance staff members on site at any one time, resulting in typically 2 visits to the site on any one day made by a car or light goods vehicle.

The provision of parking spaces for use by staff during the operational period will form part of the internal substation compound layout.

15.1.10.4 Decommissioning Phase

The design life of the wind farm is 30 years after which time a decision will be made to determine whether or not the turbines will be replaced by new turbines or if decommissioning will occur. If the site is decommissioned, cranes will disassemble each turbine tower and all turbine equipment.

All 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, the substation and grid route 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.

The traffic effects on the surrounding road network during decommisioning will be similar in nature as those forecast for the construction stage, although will be significantly less in terms of traffic generation and duration.

15.1.10.5 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 2.5 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 Cahermurphy Two Wind Farm 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 15.25.

Forestry and tree felling activity takes place at present and will continue in the future with or without the proposed wind farm. It is noted that traffic movements relating to this activity did possibly contribute to background traffic levels, but there may be cumulative traffic effects between forestry operations locally and the proposed Cahermurphy Two Wind Farm during time periods that tree felling takes place and in particular if this occurs during the construction phase. During the operational phase, which is when most of the forestry operations will be occurring i.e. over the 30-year life of the project the effects will be imperceptible as the proposed wind farm generates very low traffic numbers for the majority of its lifetime.

If it is assumed that tree felling takes place in coups of 20 hectares at a time, generating approximately 200 HGV movements over 10 working days (or 20 HGV movements daily) the cumulative impact on these days is forecast to be slight even if it occurs during the construction phase of the proposed development.

It should be noted that additional tree felling required for the proposed wind farm development site works is included in the direct impacts assessed previously in this section. It is noted that all general forestry activity will be curtailed on the site during the construction of the proposed development.

The replanting lands are located in counties Roscommon, Clare, Galway and Cavan and therefore are not likely to contribute to potential cumulative impacts with the proposed wind farm development in terms of traffic impacts.

All other wind farm developments located within a 20km radius and shown in Figure 2-1 of Chapter 2 are also listed in Table 15.25. It is noted that all of these developments are either complete, or will be complete when the proposed development reaches the construction stage, resulting in no potential for cumulative impact between the proposed development and the neighbouring developments.

Table 15.25 Summary of projects considered in cumulative assessment and potential for cumulative traffic effects with proposed Cahermurphy Two Wind Farm

Project	Status	Degree of overlap of highway network (low / medium / high)	Traffic volumes (low / medium / high)	Potential cumulative traffic effects
1 Glenmore Wind Farm	Under construction	High	Medium	None – will be complete before construction of Cahermurphy Two Wind Farm
2 Forestry / Tree Felling	Operational	Not relevant	Not relevant as it is assumed that traffic associated with ongoing forestry activities will be the same or similar to existing levels.	Included in background traffic levels

Project	Status	Degree of overlap of highway network (low / medium / high)	Traffic volumes (low / medium / high)	Potential cumulative traffic effects
3 Glenmore sub-station	Under construction	High	Low	None – will be complete
4 Booltiagh sub-station extension	Under construction	High	Low	None – will be complete
5 Cahermurphy Wind Farm & amendment	Operational	High	Medium	None – will be complete
6 Booltiagh Wind Farm	Operational	Not relevant	Not relevant	Included in background traffic levels
7 Booltiagh Wind Farm Extension	Operational	Not relevant	Not relevant	Included in background traffic levels
8 A 38kv overhead line to 110kv Booltiagh substation	Under construction	High	Low	None – will be complete
9 Letteragh Wind Farm	Operational	Not relevant	Not relevant	Included in background traffic levels
10 Boolynagleragh Wind Farm	Operational	Not relevant	Not relevant	Included in background traffic levels
11 Boolynagleragh Wind Farm Extension	Operational	Not relevant	Not relevant	Included in background traffic levels
12 Glenmore Quarry	Operational	Not relevant	Not relevant	Included in background traffic levels
13 Moanmore Wind Farm	Operational	Not relevant	Not relevant	Included in background traffic levels
14 Moneypoint Wind Farm	Operational	Not relevant	Not relevant	Included in background traffic levels

15.1.10.6 Mitigation Measures

This section summarises the mitigation measures to minimise the effects of the proposed Cahermurphy Two Wind Farm 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 15.1.8.
- All of the gravel and stone material will be obtained from on-site borrow pits.
- Construction of temporary improvements to the local highway network at locations identified in Section 15.1.8.

Mitigation Measures During the Construction Stage

The successful completion of this project will require significant coordination and planning and a 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. The range of measures will include the following which are also set out in the CEMP Section 6, Traffic Management Plan.

Delivery of abnormal sized loads

The following are main points to note for these deliveries which will be at night;

- 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 Roads Authority and An Garda Siochana.
- It is estimated that 90 abnormal sized loads will be delivered to the site, comprising 30 convoys of 3, undertaken over 30 separate nights.
- These nights will be spread out over an approximate period of 15 weeks.
- In order to manage each of the travelling convoys, for each convoy there will be approx. 2 x police escort vehicles that will stop traffic at the front and rear of the convoy of 3 vehicles.
- There will also be 2 escort vehicles provided by the haulage company for each convoy.

Other traffic management measures

A detailed **Traffic Management Plan (TMP)**, incorporating all the mitigation measures is submitted as part of the CEMP included in Appendix 4-4 of this EIAR, will be finalised and confirmatory detailed provisions in respect of traffic management agreed with the roads 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 Clare 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 Clare County Council Road Section and An Garda Siochana, 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 15.1.8. In addition, in order to minimise the impact on the existing environment during turbine component deliveries the option of blade adaptor trailers can also be used where deemed necessary.

Identification of delivery routes – These routes assessed in this EIAR will be agreed and adhered to by all contractors.

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 within the construction compound.

Delivery times of large turbine components - The management plan will include the proposal to deliver the large wind turbine plant components at night in order to minimise disruption to general traffic during the construction stage.

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.

Re-instatement works - All road surfaces and boundaries will be re-instated to pre-development condition, as agreed with the local authority engineers. A roads conditions survey (and any other analyses) where requested by the Roads Section of the Council would be undertaken immediately prior to construction commencement of the project to assess the condition of the road network at that time and to agree any required works with the local authority. Where such a survey is requested by Clare County Council it would be repeated immediately after completion of the construction phase of the project in order to ensure that any reinstatement works were carried out to a satisfactory standard as required by the local authority.

Road Opening Licence – Roads works associated with the grid connection cabling will be undertaken in line with the requirements of a road opening licence as agreed with Clare County Council.

Diversions and road closures – reasonable access to residences, farms and businesses will be maintained at all times during any road closures associated with the cable works. The details of this will be agreed with the roads authority in advance of works taking place. The network of local roads in the area will be used for traffic diversions for local traffic in order to expedite the works and limit the duration of the impact owing to the cabling works.

Trench Reinstatement - Trenches on public roads, once backfilled, will be temporarily reinstated to the satisfaction of the roads authority. Following temporary reinstatement of trenches sections of public roads along which the cable route travels will receive a surface overlay subject to agreement with the roads authority. If required, the roads conditions survey, which will be undertaken immediately prior to construction commencement of the project, will ensure that any roads along the trench routes are not left in a degraded condition. The repetition of the survey immediately after completion of the construction phase of the project will ensure that any reinstatement works were carried out to a satisfactory standard.

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 Wind Farm 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.

15.1.10.7 Residual Impacts

Construction Stage

During the 12 to 18 month construction stage of the Cahermurphy Two Wind Farm development, it is forecast that the additional traffic that will appear on the delivery route indicated in Figure 15.2a will have a slight to moderate negative and temporary impact on existing road users, which will be minimised with the implementation of the mitigation measures included in the traffic management plan in the CEMP.

Road works required to lay the grid connection cable will generally be installed in the corridor of the road, and will result in local short term delays and diversions to traffic and road closures. While traffic delays will be incurred resulting in a slight, temporary impact on local traffic, and potentially on local businesses, it is noted that only a short section of the cable route, and the very limited number of trips passing through it, will be affected each day due to delays and / or local diversions.

Operational Stage

As the traffic impact of the proposed 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. It is considered that the potential impacts will be similar or less than the construction phase with the traffic movement being a mirror of the construction phase. The concrete and steel used in the turbine bases and the substation will remain in situ and so there will be no traffic impact associated with this.

15.2 Telecommunications and Aviation

15.2.1 Introduction

This section of the EIAR assesses the likely significant effects of the proposed development on telecommunications and aviation. Section 15.2.3 describes the way in which wind turbines can potentially interfere with telecommunications signals or aviation activities. Section 15.2.4 presents details on how such effects will be avoided, with the likely significant effects assessed (and mitigation measures proposed) in Section 15.2.5.

15.2.1.1 Statement of Authority

This section of the EIAR has been prepared by Eoin O'Sullivan and reviewed by Michael Watson, both of MKO. Eoin is an experienced geo-environmental scientist and has over ten years' experience in the assessment of a wide range of energy and infrastructure related projects and working in the fields of environmental and human health risk assessment, waste management, waste policy and permitting. Eoin has also got extensive experience in the preparation of material assets assessments and reports for EIAs, particularly relating to wind energy. Eoin has also experience in completing PPC Permit Applications and in the preparation of Environmental Impact Statements/Environmental Impact Assessment Reports for renewable energy projects, quarries and a number of non-hazardous landfill sites and anaerobic digesters for both public and private clients. Eoin is also proficient in undertaking detailed quantitative risk assessments for the protection of controlled waters and human health. Eoin holds an MSc in Environmental Engineering and is a Chartered Member of the Chartered Institute of Water and Environmental Management (CWEM) and Chartered Environmentalist (CEnv) with the Society of Environment. Michael has over seventeen years' experience in the environmental sector and had worked for the Geological Survey of Ireland and then a prominent private environmental & hydrogeological consultancy prior to joining MKO in 2014. Michael completed an MA in Environmental Management at NUI, Maynooth in 1999. Michael is a professional geologist (PGeo) and full member of IEMA (MIEMA) as well as a Chartered Environmentalist (CEnv).

15.2.2 Methodology and Guidance

This section of the EIAR has been prepared in line with the guidance set out by:

- '*Guidelines on the Information to be contained in Environmental Impact Statements*' (EPA, 2002).
- *'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 Assessment Reports DRAFT"* (EPA, 2017).

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 2.5 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, Section 3.5 of the EIAR.

The assessment of likely significant effects on material assets uses the standard methodology and classification of impacts as presented in Section 1.7.2 of Chapter 1 of this EIAR. The full project description, including proposed turbine locations and elevations, is provided in Chapter 4.

15.2.3 Background

15.2.3.1 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.

15.2.3.2 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 (Shadowed and Scattered), 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.

15.2.3.3 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. The nearest such operational airport to the Proposed Development site is Shannon Airport, located approximately 32 kilometres southeast of the site, and therefore outside the range at which such issues would be expected. .

15.2.4 Preventing Electromagnetic Interference

15.2.4.1 National Guidelines

The '*Wind Energy Development Guidelines for Planning Authorities'* (Department of the Environment, Heritage and Local Government, 2006) 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 2.5 in Chapter 2 of this EIAR.

15.2.4.2 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 15-26.

Table 15-26 Telecommunications and Aviation Scoping Responses

Consultee	Response	Potential for Interference Following Consultation Exercise
Airspeed	Received 1st April 2019	Yes – see below
Broadcasting Authority of Ireland	Received 5th June 2019	No
BT Communications Ireland	Received 28th February 2019	No
ComReg (Commission for Communications Regulation)	Received 28th February 2019	No
Department of Defence	Received 26th June 2019	No
Eir	Received 28th February 2019	No
BBnet (EOBO)	Received 01st April 2019	No
ESB Telecoms	Received 29th May 2019	No
Irish Aviation Authority	Received 13th June 2019	No
Imagine Group	6th March 2019	No
Ripplecom	28th February 2019	No
RTE Transmission Network (2rn)	Received 28th February 2019	Yes – see below
Shannon Airport	Received 11th June 2019	Yes – see below.
Tetra Ireland Communications (emergency services)	Received 06th March 2019	No
Towercom	Received 11th March 2019	No
Three Ireland Ltd	No response received to date	No
Viatel	Received 01st April 2019	No
Virgin Media	Received 28th February 2019	No

Consultee	Response	Potential for Interference Following Consultation Exercise
Vodafone Ireland	Received 28th February 2019	No

The scoping responses from the telecommunications and aviation consultees are described below. Relevant copies of scoping responses are provided in Appendix 2-1.

15.2.4.2.1 Broadcasters

RTÉ Transmission Network (operating as 2rn), stated that that there is a risk of disruption to television reception for viewers to the west of the site that receive their signal from Maghera and for viewers to the northeast of the site that receive their signal from Knockanore. To mitigate against interference on viewers' television sets and/or broadcast radio receivers, RTÉ have recommended that a protocol agreement be put in place for the wind farm development. 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.

15.2.4.2.2 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.

Airspeed

Airspeed replied to a scoping request from MKO on the 1st April 2019, noting that they had one link in the area of the proposed development. In a further response from Airspeed, they noted that a clearance of 15 metres was to be maintained between the turbines and the Airspeed link.

On review by both Airspeed and MKO, it was concluded that the proposed wind farm location is below the A-End and B-End of the link and therefore there was sufficient clearance available between the proposed blade tip and the Airspeed link.

It should also be noted that all turbine locations are outside the 100 metre buffer which has been applied by MKO to the Airspeed link.

15.2.4.2.3 Aviation

As noted in Table 15-26 above, scoping responses were received from the following aviation consultees:

- Department of Defence
- Irish Aviation Authority
- Shannon Airport

Pertinent information has been summarised below, however the scoping responses should be referenced to for further detail:

Department of Defence

In June 2019, a scoping response was received from the Department of Defence (DoD) 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.*

Irish Aviation Authority

In June 2019, a scoping response was received from the Irish Aviation Authority (IAA). The requirements of the IAA include the following:

1. *Agree an aeronautical obstacle warning light scheme for the wind farm development.*
2. *Provide as-constructed coordinates 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.*

Shannon Airport

In June 2019, a scoping response was received from Shannon Airport which included the following general comments:

1. *The siting of wind turbines at this location may have implications for the operations of the communication, navigation and surveillance systems used by Air Traffic Control for the separation and safety of aircraft. The geographical siting of these turbines may also have implications for the flight paths of aircraft.*
2. *Regard must be had to the Irish Aviation Authority (IAA) Obstacles to Aircraft in Flight Order, 2002 (S.I. No. 14 of 2002), as amended, which specifies the criteria used to determine whether or not any object anywhere in the state is deemed to be an obstacle affecting aircraft operations. Also, in order to assure the safety and efficiency of aircraft operations in the vicinity of airports, the International Civil Aviation Organisation (ICAO) has defined a volume of air space above which new objects are not permitted to interfere.*
3. *It would also be best practice that all wind energy developers should seek the views of the Irish Aviation Authority (IAA) at the pre-planning stage of consultation, with details of locations and proposed heights of turbines, to ensure that proposed developments do not cause difficulties with air navigation safety.*
4. *In the event that any potential adverse effects relating to this wind turbine development were identified as part of the consultation process, Shannon Airport Authority DAC would fully support any submission from the IAA.*
5. *Final, should planning permission be granted for this development in the future, we would ask that the planning authority stipulate the mandatory deployment of obstacle avoidance lighting on each individual wind turbine in the interests of flight safety.*

The nearest operational airport to the Proposed Development site is Shannon Airport, located approximately 32 kilometres southeast of the site, and therefore outside the range at which such issues would be expected.

In response to the lighting requirements requested by the DoD, IAA and Shannon Airport the turbines will be marked on maps, lit at night and entered into aircraft navigation databases and therefore can be avoided during flight.

15.2.5 Likely Significant Effects and Associated Mitigation Measures

15.2.5.1 'Do-Nothing' Scenario

If the proposed development were not to proceed, there would be no change to existing telecommunications and aviation operations in the area.

15.2.5.2 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.

15.2.5.3 Operational Phase

15.2.5.3.1 *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

In the event of interference occurring to telecommunications, the Department of the Environment, Heritage and Local Government *'Wind Farm Planning Guidelines'* (2006) acknowledge that '*electromagnetic interference can be overcome'* by the use of divertor relay links out of line with the wind farm.

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 effect on telecommunications from the proposed development.

15.2.5.3.2 *Aviation*

Pre-Mitigation Impact

The scoping response of the DoD, IAA and Shannon Airport has requested that standard lighting requirements be used at the proposed wind farm.

Mitigation Measures

The scoping response from the DoD, IAA and Shannon Airport 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 DoD, IAA and Shannon Airport. 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 requirements will be met by the applicant.

Significance of Effects

There will be no significant effect on aviation operations due to the proposed development.

15.2.5.4 Cumulative Effect

Chapter 2, Section 2.7 of this EIAR describes the methodology used in compiling the list of projects considered in the assessment of cumulative effects, and provides a description of each project, including current status. Although there are three wind farms within 5 kilometres of the proposed development (the permitted Cahermurphy Wind Farm site, the permitted Kiltumper Wind Farm and the permitted Glenmore Wind Farm), there will be no cumulative impacts relating to the proposed development and surrounding projects in relation to Telecommunications or Aviation.

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. It is on this basis that it can be concluded that there would be a long-term imperceptible cumulative impact from the proposed development and other developments in the area.

16. INTERACTION OF EFFECTS

16.1 Introduction

The preceding Chapters 5 to 15 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. 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 improve them, or have a neutral effect.

A matrix is presented in Table 16-1 below to identify potential interactions of impacts between the various aspects of the environment already assessed in this EIAR. The matrix highlights the potential for the occurrence of positive, neutral 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 16-1 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										
	O										
Biodiversity, Flora and Fauna	C										
	O										
Ornithology, Birds	C										
	O										
Land, Soils and Geology	C										
	O										
Water	C										
	O										
Air and Climate	C										
	O										
Noise and Vibration	C										
	O										
Landscape and Visual	C										
	O										
Cultural Heritage	C										
	O										
Material Assets	C										
	O										

Legend: **No Interacting Effect:** **Positive Effect:**
Neutral Effect: **Negative Effect:**

The potential for interaction of impacts has been assessed, throughout this EIAR, as part of the Impact Assessment process. While the work on all parts of the Environmental Impact Assessment Report (EIAR) was 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 impacts that potentially interact have been assessed in detail in the individual chapters of the EIAR above and summarised in Section 16.2 below.

Where any potential negative impacts have been identified during the assessment process, these impacts have been avoided or reduced by by design and the proposed mitigation measures, as presented throughout the EIAR and highlighted in Section 16.2 below.

16.1.1 Statement of Authority

This section of the EIAR has been prepared by Eoin O'Sullivan and reviewed by Michael Watson, both of MKO. Eoin O'Sullivan is employed as a Senior Environmental Consultant with MKO. Eoin has twelve years' experience in the assessment of a wide range of energy and infrastructure related projects and working in the fields of environmental and human health risk assessment, waste management, waste policy and permitting. Eoin has wide experience in the project management of large scale infrastructural projects and brownfield developments. Eoin holds an MSc in Environmental Engineering and is a Chartered Member of the Chartered Institute of Water and Environmental Management (CWEM) and Chartered Environmentalist (CEnv) with the Society of Environment. Michael has over seventeen years' experience in the environmental sector and had worked for the Geological Survey of Ireland and then a prominent private environmental & hydrogeological consultancy prior to joining MKO in 2014. Michael completed an MA in Environmental Management at NUI, Maynooth in 1999. Michael is a professional geologist (PGeo) and full member of IEMA (MIEMA) as well as a Chartered Environmentalist (CEnv).

16.2 Impact Interactions

16.2.1 Population and Human Health

Population and Human Health, Air and Climate, 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 12 not be implemented.

During the operational phase the proposed development has the potential to generate noise but as identified in Chapter 12, the potential effects on population and human health are not siginificant.

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 be reduced effects from climate change on human health over the 'do-nothing' scenario and continuing reliance on generating 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 11.

Population and Human Health and Water

As described in Chapter 10 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 same catchment. Mitigation measures are presented in Chapter 10 to minimise the potential of any such issues occurring.

Population and Human Health, and Material Assets

Chapter 15 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.. A Traffic Management Plan will be in place to minimise all disruption insofar as possible, as outlined in the Section 15.1 of this EIAR.

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 13 of this EIAR, concludes that, from 13 viewpoints assessed, the visual effect will be moderate from five location and ranges from imperceptible to slight at the remaining locations. Therefore, it is considered that the overall visual impact of the proposed development will not be significant.

16.2.2 Biodiversity

Biodiversity and Land, Soils and Geology

The removal of forestry, peat and spoil, during construction of the proposed development, is likely to result in some disturbance of flora and fauna in the 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 used for the restoration of the proposed borrow pit.

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 7 and Chapter 10 of this EIAR, and the relevant measures outlined in these chapters will be in place to avoid any water pollution and subsequent effect on flora and fauna.

Biodiversity and Air and Climate

During the construction phase of the proposed development, increased vehicular and dust emissions within and around the site have the potential to be a nuisance to flora and fauna, thereby having a temporary, slight, negative effect. The mitigation measures outlined in Chapter 11 of the EIAR will ensure that the potential for negative effects is reduced or eliminated.

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. Best practice mitigation measures are included in Chapter 7 and Chapter 12 to minimise the potential negative effect of noise generated during the construction phase on biodiversity.

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.

16.2.3 Ornithology

Ornithology and Land, Soils and Geology

The removal of forestry, peat and spoil, during construction of the proposed development, is likely to result in some disturbance of flora and fauna, including birds, in the areas surrounding the proposed works area thereby, potentially causing an indirect long term, slight, negative effect on birds.

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 10 of this EIAR not be implemented.

Ornithology and Air and Climate

During the construction phase of the proposed development, increased vehicular and dust emissions within and around the site have the potential to be a nuisance for birds, thereby having a temporary, slight, negative effect. The mitigation measures outlined in Chapter 11 of the EIAR will ensure that the potential for negative effects is reduced or eliminated.

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.

Ornithology 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 8 and Chapter 12 to minimise the potential negative effect of noise generated during the construction phase on ornithology.

16.2.4 Land, Soils and Geology

Land, Soils and Geology and Water

As identified in Chapter 10 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 through potentially silt-laden runoff from the proposed works areas. Mitigation measures to ensure there are no significant, negative effects on water quality are presented in Chapter 10.

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 14 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.

16.2.5 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 11 of this EIAR, and mitigation measures are presented to minimise any potential effects.

16.2.6 Landscape and Visual

Landscape and Visual and Cultural Heritage

As described in Chapter 14 of this EIAR, the proposed development has the potential to change the landscape setting of recorded sites and monuments in the wider area. However, it is concluded in Chapter 14 that any potential, indirect, visual effect of the proposed development on national and recorded monuments would not be significant.

16.3 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 5-15) 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.

17. SCHEDULE OF MITIGATION

17.1 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 17-1. 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
- Felling
- Peat, subsoils and bedrock
- 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 4-4 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.

17.2 EIAR Mitigation and Monitoring Measures

Table 17-1 Schedule of Mitigation Cahermurphy Two Wind Farm

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
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.		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
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 2m.		
MM6	Drainage	CEMP Section 3	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	Traffic Management Plan, Delivery Programme, pre-commencement road works	EIAR Chapter 15	› 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:		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
			▸ 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		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
			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 Clare County Council Road Section and An Garda Siochana, 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 15.1.8. In addition, in order to minimise the impact on the existing environment during turbine component deliveries the option of blade adaptor trailers can also be used where deemed necessary. Identification of delivery routes – These routes assessed in this EIAR will be agreed and adhered to by all contractors. › 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 within the construction compound. › Delivery times of large turbine components - The management plan will include the proposal to deliver the large wind turbine		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
			plant components at night in order to minimise disruption to general traffic during the construction stage. › 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 site and sweeping / cleaning of local roads as required. › Re-instatement works - All road surfaces and boundaries will be re-instated to pre-development condition, as agreed with the local authority engineers. A roads conditions survey (and any other analyses) where requested by the Roads Section of the Council would be undertaken immediately prior to construction commencement of the project to assess the condition of the road network at that time and to agree any required works with the local authority. Where such a survey is requested by Clare County Council it would be repeated immediately after completion of the construction phase of the project in order to ensure that any reinstatement works were carried out to a satisfactory standard as required by the local authority.		
MM9	Information to Local Residents	EIAR Chapter 15	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					
MM10	Health and Safety	EIAR Chapter 5	During construction of the Proposed Development, all staff will be made aware of and adhere to:		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
			› 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). 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.		
MM11	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;		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
			› 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		
MM12	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;		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
			› 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.		
MM13	Refuelling,	EIAR Chapter 4, 7, 9, 10 CEMP Section 3	On-site refuelling will be carried out using a mobile double skinned, bunded fuel bowser. The fuel bowser, a double-axel 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 development. 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 when not in use. Refuelling operations will be carried out only by designated trained and competent operatives holding a permit to refuel. Mobile anti-pollution measures such as drip trays and fuel absorbent mats will be used during all refuelling operations.		
MM14	Borrow Pits	EIAR Chapter 4	The borrow pits areas will be permanently secured and a stock-proof fence will be erected around the borrow pit areas to prevent access to these areas. Appropriate health and safety signage will also be erected on this fencing and at locations around the fenced area.		
MM15	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					
MM16	Earthworks	EIAR Chapter 10	Avoid working during heavy rainfall and for up to 24 hours after heavy events to ensure drainage systems are not overloaded.		
MM17	Excavation Dewatering and	EIAR Chapter 10	› If required, pumping of excavation inflows will prevent build-up of groundwater in the excavation;	›	›

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
	Surface Water Quality		› 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.		
MM18	Watercourse Buffers	EIAR Chapter 10	During the wind turbine construction phase a self-imposed buffer zone of 50 metres will be maintained for all streams where possible.		
MM19	Near Stream Works	EIAR Chapter 10	› During the near stream construction work double row silt fences will be emplaced immediately down-gradient of the construction area for the duration of the construction phase. There will be no batching or storage of cement allowed in the vicinity of the crossing construction areas. › As a further precaution, near stream construction work, will only be carried out during the period permitted by Inland Fisheries Ireland for in-stream works according to the Eastern Regional Fisheries Board (2004) guidance document "Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites", i.e., May to September inclusive. This time period coincides with the period of lowest expected rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
			this pathway to surface watercourses (any deviation from this will be done in discussion with the IFI)		
MM20	Drainage Swales	EIAR Chapter 10, 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.		
MM21	Interceptor Drains	EIAR Chapter 10, 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.		
MM22	Transverse drains	EIAR Chapter 10, 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/roadside drains;		
MM23	Check dams	EIAR Chapter 10, Appendix 4-5	Check dams will not be used in any natural watercourses, only artificial drainage channels and interceptor drains. Check dams will be used along sections of access road drains to intercept silts at source		
MM24	Level Spreaders	EIAR Chapter 10, Appendix 4-5	Level spreaders will be constructed at the end of interceptor drains to convert concentrated flows in the drain into diffuse sheet flow on areas of vegetated ground.		
MM25	Settlement ponds	EIAR Chapter 10, 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.		
MM26	Siltbuster	EIAR Chapter 10, 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		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
			surface discharge water collected in the dirty water drainage system. This will apply for all of the construction phase.		
MM27	Silt Fences	EIAR Chapter 10, 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.		
MM28	Silt Bags	EIAR Chapter 10, 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.		
MM29	Potential Release of Hydrocarbons	EIAR Chapter 10 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;		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
			› 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.		
MM30	Plant and equipment inspections	EIAR Chapter 9	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 Environmental Management Plan. Spill kits will be available to deal with accidental spillages.		
MM31	Wastewater Disposal	EIAR Chapter 10	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 permitted waste collector to wastewater treatment plants. It is not proposed to treat wastewater on-site.		
MM32	Concrete Deliveries and Management	EIAR Chapter 10, 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.		
MM33	Concrete Deliveries and Management	EIAR Chapter 10, CEMP Section 3	No washing out of any plant used in concrete transport or concreting operations will be allowed on-site.		
MM34	Concrete Deliveries and Management	EIAR Chapter 10, 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		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
			dedicated lined washout area. This lined area will be removed from site once the construction phase is complete.		
MM35	Concrete Deliveries and Management	EIAR Chapter 10, 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		
MM36	Concrete Deliveries and Management	CEMP Section 3	Where possible pre-cast elements for culverts and concrete works will be used		
Felling					
MM37	Felling Licence	EIAR Chapter 4	Felling will be carried out under the terms of a licence application to the Forest Service, as per the Forest Service's policy on granting felling licenses for wind farm developments		
MM38	Clear felling of Coniferous Plantation	EIAR Chapter 4. CEMP Section 3	› Works will be overseen by an ECoW. › The extent of all necessary tree felling will be identified and demarcated with markings on the ground in advance of any felling commencing. › All roads and culverts will be inspected prior to any machinery being brought on site to commence the felling operation. No tracking of vehicles through watercourses will occur. Vehicles will only use existing road infrastructure and established watercourse crossings. › Existing drains that drain an area to be felled towards surface watercourses will be blocked, and temporary silt traps (which may include a combination of the drainage components outlined in Section 4.6.3) will be constructed to ensure collection of all silt within felling areas. These temporary silt traps will be cleaned out and backfilled once felling works are complete. This ensures there is no residual collected silt remaining in blocked drains after felling works are completed.		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
			No direct discharge of such drains to watercourses will occur from within felling areas. › New collector drains and sediment traps will be installed during ground preparation to intercept water upgradient of felling areas and divert it away. Collector drains will be excavated at an acute angle to the contour (0.3%-3% gradient), to minimise flow velocities. › All silt traps will be sited outside of buffer zones and have no direct outflow into the aquatic zone. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of away from all aquatic zones. › All new collector drains will taper out before entering the aquatic buffer zone to ensure the discharging water gently fans out over the buffer zone before entering the aquatic zone. › Machine combinations, such as mechanical harvesters or chainsaw felling, will be chosen which are most suitable for ground conditions at the time of felling, and which will minimise soils disturbance; › Mechanised operations will be suspended during and immediately after heavy rainfall. › Where brash is required to form brash mats, it is to be laid out at harvesting stage to prevent soil disturbance by machine movement. › Brash which has not been pushed into the soil may be moved within the site to facilitate the creation of mats in more demanding locations. › Felling of trees will be pointed directionally away from watercourses.		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
			› Felling will be planned to minimise the number of machine passes in any one area. › Extraction routes, and hence brash mats, will be aligned parallel to the ground contours where possible. › Harvested timber will be stacked in dry areas, and outside any 50-metre watercourse buffer zone. Straw bales and check dams to be emplaced on the down gradient side of timber storage sites. › Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed, but removing of natural debris deflectors will be avoided.		
Peat, Subsoils and Bedrock					
MM39	Topsoil/Peat and Subsoil Excavation	EIAR Chapter 9	› 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.		
MM40	Peat Instability and Failure	EIAR Chapter 9	› Appointment of experienced and competent contractors; › The site should be supervised by experienced and qualified personnel;		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
			› Allocate sufficient time for the project (be aware that decreasing the construction time has the potential to increase the risk of initiating a 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; › Ensure construction method statements are followed or where agreed modified/ developed; and, › Revise and amend the Geotechnical Risk Register as construction progresses.		
MM41	Erosion of Exposed Subsoils and Peat During Tree Felling and Construction works	EIAR Chapter 9 and Appendix 4-2	› All excavated material will be completed in accordance with the Peat and Spoil Management Plan. Material will be moved over the least possible distance. › Any excess peat will be moved to peat storage areas or will be temporarily surrounded by earthen berms to prevent erosion. This will prevent erosion of soil. Silt fences will be installed around temporary stockpiles to limit movement of entrained sediment in surface water runoff. The use of earthen berms and silt fencing around earthworks and spoil mounds will prevent egress of water from the works.		
MM42	Erosion of Exposed Subsoils and Peat During Tree Felling and Construction works	EIAR Chapter 9	Any excess temporary mounded peat in storage for long periods will be surrounded by earthen berms or seeded at the earliest opportunity.		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
MM43	Erosion of Exposed Subsoils and Peat During Tree Felling and Construction works	EIAR Chapter 9	During tree felling brash mats will be used to support vehicles on soft ground, reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur.		
Biodiversity					
MM44	Rhododendron Management Plant	EIAR Chapter 7 CEMP Section 3	Where works are proposed along the proposed grid connection route which will directly impact on a particular stand of Rhododendron the following methods will be employed: › Digging: Where the stand is small enough removal will be carried out manually by hand. Where stands are too large to be completely removed the stand will need to be removed by digging. Removal will take place outside of the optimal seed dispersal period (Feb/March) and flowering season (Spring/Summer). The effectiveness of digging the stumps and root ball out is increased by removing all viable roots. This will be done manually or with an excavator. To avoid regrowth, stumps and root balls will be turned upside down and the soil should be brushed off the roots. › Excavated Plant Material: Soil will be removed from excavated material and the material will be placed inverted on a root barrier membrane within the works area. This will be located >30m from any watercourse. The plant material will be stored here and allowed to completely dry out. Once dry, the rhododendron material shall be mulched on site and composted or burned.		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
			› An Environmental Clerk of Works (ECoW) or suitably qualified Ecologist will be required to monitor rhododendron management works. The ECoW shall confirm that the risk of contamination beyond the already contaminated area is avoided prior to the commencement of any works. Biosecurity measures on the site will stay in place until all works are completed.		
MM45	Invasive Species	Appendix 7-4	› Good construction site hygiene will be employed to prevent the introduction and spread of problematic invasive alien plant species (e.g. Himalayan balsam, Japanese knotweed etc.) by thoroughly washing vehicles prior to leaving the site. › All plant and equipment employed on the construction site (e.g. excavator, footwear, etc.) will be thoroughly cleaned down using a power washer unit prior to arrival on site to prevent the spread of invasive plant species › Wheel washing facilities will be provided at the site entrance. All washing must be undertaken in areas with no potential to result in the spread of invasive species. This process will be detailed in the contractor's method statement. › Any soil, topsoil or stone material required on the site will be sourced from a stock that has been screened for the presence of any invasive species and where it is confirmed that none are present.		
Ornithology					
MM46	Hen Harrier and Peatland Habitat Enhancement Plan	EIAR Chapter 8 and	Hen Harrier and Peatland Habitat Enhancement Plan will be implemented to enhance potential habitats and minimise potential habitat loss. Management prescriptions to be implemented by the applicant include:		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
		Appendix 8-8	› Forestry and brash will be removed on the site and the area will be allowed to revert to open peatland habitat. Pre-mature felling of forestry will be undertaken in accordance with a felling licence, before the first breeding season of the construction phase of the project programme. This would allow time for the clear-felled site to revegetate in advance of the operational phase. › Reinstatement of livestock proof fencing. › Re-vegetation with native vegetation is therefore expected to occur naturally within the enhancement area. › Forestry drainage channels will be blocked, using peat dams or plastic dams, as appropriate. In flat areas drain blocks should be placed every 15m and more frequently when accounting for a slope. › Habitat maintenance of the enhancement area will involve the eradication of self-seeding conifers, and removal off-site. It is envisaged that the enhancement areas will require maintenance twice during the life of the wind farm, once during the construction phase and once after approximately 12 years. › In the event of any invasive species being recorded within the area identified for enhancement measures, an invasive species management plan will be put in place to eradicate any stands of such species. A pre-commencement survey for invasive species to confirm the conditions predicted in this EIAR will be undertaken as part of preparatory work and if recorded an Invasive species management plan shall be prepared. › Enhancement and maintenance works will be undertaken outside of the nesting season as per the Wildlife Act 1976, as amended.		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
MM47	Ornithology	EIAR Chapter 8	› Taking a precautionary approach, it is proposed that construction works will commence outside the bird nesting season (1st of March to 31st of August inclusive). › In addition, to avoid impacting breeding hen harrier along the grid connection route no construction works shall be undertaken within a 500m buffer (Forestry Commission Scotland 2006; Ruddock & Whitfield 2007) of the Doo Lough hen harrier territory. See Figure 1-1 in confidential appendix 8.7 for territory location. No works shall be permitted within the buffer between the 1st of March and the 31st of August or until it can be demonstrated that the nest is no longer occupied. › The removal of woody vegetation will be undertaken in full compliance with Section 40 of the Wildlife Act 1976 – 2018. Where sections of woody vegetation are removed for the purposes of the junction and road upgrades, these will be replaced with suitable hedge/tree species which are common in the local context. › 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 machinery will be turned off when not in use. › All plant and equipment for use will comply with the Construction Plant and Equipment Permissible Noise Levels Regulations 1996 (SI 359/1996) and other relevant legislation. › An Ecological Clerk of Works (ECoW) will be appointed and will operate for the duration of construction works. Duties will include:		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
			○ 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.		
Noise					
MM48	Best Practise Measures BS5528-1	EIAR Chapter 12	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.		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
			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.		
MM49	Blasting	EIAR Chapter 12	The methods used to minimise impacts will consist of the following: › Restriction of hours within which blasting can be conducted (e.g. 09:00 – 18:00hrs). › Notification to nearby residents before blasting starts (e.g. 24-hour written notification). › The firing of blasts at similar times to reduce the 'startle' effect. › On-going circulars informing people of the progress of the works. › The implementation of an onsite documented complaints procedure. › The use of independent monitoring by external bodies for verification of results. › Trial blasts in less sensitive areas to assist in blast designs and identify potential zones of influence.		
MM50	Rock Breaking	EIAR Chapter 12	Where rock breaking is employed in relation to the proposed borrow pit location, the following are examples of measures that will be employed, where necessary, to mitigate noise emissions from these activities:		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
			› Fit suitably designed muffler or sound reduction equipment to the rock breaking tool to reduce noise without impairing machine efficiency. › Ensure all leaks in air lines are sealed. › Use a dampened bit to eliminate ringing. › Erect acoustic screen between compressor or generator and noise sensitive area. When possible, line of sight between top of machine and reception point needs to be obscured. › Enclose breaker or rock drill in portable or fixed acoustic enclosure with suitable ventilation.		
Air Quality/Dust					
MM51	Dust Emissions	EIAR Chapter 5,11 CEMP Section 3	› In periods of extended dry weather, dust suppression may be necessary along haul roads, site roads, around borrow pit areas and other infrastructure 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, borrow pit and site compounds 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.		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
			➢ 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. ➢ The transport of dry peat and spoil, that has the significant potential to generate dust, to the on-site borrow pits will be minimised. If necessary, excavated peat and spoil will be dampened prior to transport to the borrow pits.		
MM52	Exhaust Emissions	EIAR Chapter 5, Chapter 11	➢ 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.		
MM53	Greenhouse Gas Emissions	EIAR Chapter 11	➢ 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. ➢ The majority of aggregate materials for the construction of the proposed wind farm will be obtained from the three proposed borrow pits on the site of the Proposed Development. This will significantly reduce the number of delivery vehicles accessing the site, thereby reducing the amount of emissions associated with vehicle movements.		
Traffic					

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
MM54	Traffic Management Co-Ordinator	EIAR Chapter 15	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.		
MM55	Liaison with the relevant local authority	EIAR Chapter 15	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.		
MM56	Travel Plans for Construction Workers	EIAR Chapter 15	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.		
MM57	Temporary traffic signs	EIAR Chapter 15	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.		
Cultural Heritage					
MM58	Site Infrastructure	EIAR Chapter 14	› Care will be taken to minimise damage to the townland boundary wall during the construction phase. › The section of stone wall townland boundary which is to be removed to facilitate the construction of the met mast access road will be recorded by means of photographs and a written description prior to removal. › Groundworks at the three specified townland boundary locations shall be monitored and any sub-surface traces of the townland boundaries shall be recorded by means of photographs, written descriptions and scale drawings if necessary. › Sections of old field walls which are to be removed to facilitate the construction of access roads and other infrastructure will be recorded by means of photographs and written descriptions prior to removal.		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
			› The gate post will be salvaged and reused at an appropriate location.		
Operational Phase					
Health and Safety					
MM59	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. 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 30m (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;		

Ref. No.	Reference Heading	Location	Mitigation Measure	Audit Result	Action Required
			➢ "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.		
MM60	Decommissioning	CEMP Section 2.5	A decommissioning plan will be agreed with the local authorities three months prior to decommissioning the Proposed Development.		
Traffic Management					
MM61	Roads	EIAR Chapter 15	**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		
Drainage Management Plan					
MM62	Drainage Inspection	EIAR Chapter 10, 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.		

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.

Clare County Council, Clare County Development Plan 2017-2023 (as varied)

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.

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.

Southern Regional Assembly, Regional Spatial and Economic Strategy for the Southern Region, 2020

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.

United Nations (2019). COP25 Climate Change Conference, Madrid.

Consideration of Reasonable Alternatives

Clare County Council (2017) Clare County Development Plan 2017– 2023.

Department of the Environment, Heritage and Local Government (2006). Wind Energy Development Guidelines

Department of Housing, Planning and Local Government (2013) Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review. DHPLG, 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.

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).

Irish Wind Energy Association (2008). Best Practice Guidelines for the Irish Wind Energy Industry

MKO (2018). Cahermurphy Landscape Capacity Assessment

Sustainable Energy Authority of Ireland (April 2013) Methodology for Local Authority Renewable Energy Strategies. RPS, Ireland.

Description of the Proposed Development

Central Statistics Office Ireland (2018). Census Results 2011 & 2016. www.cso.ie

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.

COFORD (2004) Forest Road Manual – Guidelines for the Design, Construction and Management of Forest Roads.

Coillte (2009). Forest Operations & Water Protection Guidelines;

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.

Forestry Act 2014

Forestry Regulations 2017

Forestry Commission (2004). Forests and Water Guidelines, Fourth Edition.

Forest Services (Draft, undated): Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures.

Forest Service, 2000: Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.

Forestry Commission, 2004: Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh.

Forest Service (2000). Forestry and Water Quality Guidelines.

Inland Fisheries Ireland (2016). Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Watercourses.

PPG1 - General Guide to Prevention of Pollution (UK Guidance Note)

PPG5 – Works or Maintenance in or Near Watercourses (UK Guidance Note)

Waste Management Act 1996 as amended

Scottish Natural Heritage, (2010). Good Practice During Wind Farm Construction

Safety and Health Commission for the Mining and other Extractive Industries (2001). Guidance on the Safe Use of Explosives in Quarries

Siltbuster Concrete Wash Unit. Available at: http://www.siltbuster.com. Accessed 19.08.2020.

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

Clare Energy Action Network (2004). Study of Community Wind Energy Development in the Parish of Kilmihil

Clare County Council (2017). County Clare Development Plan 2017 – 2023

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

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 (August 2018). 2017 Topline Tourism Performance By Region 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.

Heblich, Dr. S. et al (2016) Impact of wind Turbines on House Prices in Scotland. Climate Xchange

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.

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.

Sustainable Energy Ireland (2003). Attitudes Towards the Development of Wind Farms in Ireland'. SEI, Dublin.

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).

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.

World Health Organisation Regional Office for Europe (2018). Environmental Noise Guidelines for the European Region

Shadow Flicker

Department of the Environment, Heritage and Local Government (2006). Wind Energy Guidelines 2006.

Environmental Protection Agency (August 2017): Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports. EPA, Wexford.

Helimax Energy (2008). Shadow Flicker Analysis. Stantec, Ontario.

Irish Wind Energy Association (2012). Best Practice Guidelines for the Irish Wind Energy Industry.

Noble Environmental Power LLC (2006). Wind Fact Sheet #4: Shadow Flicker. Noble Environmental Power, Connecticut.

UK Department of Energy and Climate Change (2010). Update of Shadow Flicker Evidence Base. DECC, London.

Biodiversity

Bailey, M. and Rochford J. (2006) Otter Survey of Ireland 2004/2005. Irish Wildlife Manuals, No. 23. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Calhoun, K. and Cummins, S. (2014). Birds of Conservation Concern in Ireland 2014-2019. BirdWatch Ireland.

CIEEM (2016) Institute of Ecology and Environmental Management Draft Guidelines for Ecological Impact Assessment: Terrestrial, Freshwater and Coastal

CIEEM (2018) Institute of Ecology and Environmental Management Draft Guidelines for Ecological Impact Assessment: Terrestrial, Freshwater and Coastal

Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn.). The Bat Conservation Trust, London.

Crowe, O., Wilson, J., Aznar, I. and More, S.J. (2009). A review of Ireland's waterbirds, with emphasis on wintering migrants and reference to H5N1 avian influenza. Irish Veterinary Journal 62, 800–811.

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

EC (2007b) Interpretation Manual of European Union Habitats. Version EUR 27. European Commission, DG Environment.

EPA 2017, Draft Guidelines On The Information To Be Contained In Environmental Impact Assessment Reports, Online, Available at: https://www.epa.ie/pubs/advice/ea/EPA%20EIAR%20Guidelines.pdf, Date accessed: 01/04/2019

EPA, 2019, Water status data. Online, Available at http://www.epa.ie, Accessed: 31/10/2019.

Luxembourg. European Commission.

EC (2013) Interpretation Manual of European Union Habitats. Version EUR 28. European Commission, DG Environment.

European Communities (Environmental Impact Assessment) Regulations, 1989 to 2001.

European Communities (Natural Habitats) Regulations, SI 94/1997, SI 233/1998 & SI 378/2005 – http://www.irishstatutebook.ie.

Fossitt, J. A. (2000). A Guide to Habitats in Ireland. Dublin: The Heritage Council.

Habitats Directive (92/43/EEC).

Marnell, F., Kingston, N. & Looney, D. (2009) Ireland Red List No. 3: Terrestrial Mammals, National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

NPWS (2008) The Status of EU Protected Habitats and Species in Ireland. Conservation Status in Ireland of Habitats and Species listed in the European Council Directive on the Conservation of Habitats, Flora and Fauna 92/43/EEC.

NPWS Protected Site Synopses and maps available on http://www.npws.ie/en/ProtectedSites/.

NPWS (2019), Natural Heritage Areas (NHA), Online, Available at: https://www.npws.ie/protected-sites/nha, Accessed: 01/09/2019

NPWS (2019), Online map for protected bryophytes, http://dahg.maps.arcgis.com/apps/webappviewer/index.html?id=71f8df33693f48edbb70369d7fb26b7e, Online, Accessed: 30/10/2019.

O'Neill et al. (2009) Irish Semi Irish Semi-natural natural Grasslands Survey Annual Report No. 2: Counties Cavan, Leitrim, Longford & Monaghan. Bec Consultants

Smal, C. (1995) The Badger and Habitat Survey of Ireland. Unpublished Report to the Department of Agriculture and the National Parks & Wildlife Service.

Stace, C. A. (1997). New Flora of the British Isles. Cambridge: Cambridge University Press.

Stone, E.L. (2013) Bats and lighting: Overview of current evidence and mitigation guidance.

TII (2004) Environmental Impact Assessment of National Road Schemes – A Practical Guide, National Roads Authority, Dublin.

TII (2004) Guidelines for the Treatment of Noise and Vibration in National Road Schemes (1 ed.). Dublin: National Roads Authority.

TII (2005) Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes. Dublin: National Roads Authority.

TII (2006) Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes. Dublin: National Roads Authority.

TII (2006) Guidelines for the Protection and Preservation of Trees, Hedgerows and Scrub Prior to, During and Post-Construction of National Road Schemes. Dublin: National Roads Authority.

TII (2006) Guidelines for the Treatment of Bats during the Construction of National Road Schemes. Dublin: National Roads Authority.

TII (2008). Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan. Dublin: National Roads Authority.

TII (2009) Guidelines on Ecological Surveying Techniques for Protected Flora and Fauna on National Road Schemes. Dublin: National Roads Authority.

TII (2010b) Guidelines on management of noxious weeds and non-native invasive plant species on national roads. National Roads Authority.

Wildlife Act 1976 and Wildlife (Amendment) Act 2000.

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.

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.

British Trust of Ornithology (BTO) online BirdFacts. Available at https://www.bto.org/about-birds/birdfacts

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.

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.

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.

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.

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.

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.

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.

The Hen Harrier Project website (http://www.henharrierproject.ie/)

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) (2020) Geotechnical & Peat Stability Assessment Report for Cahermurphy Two Wind farm Co. Clare

Geological Survey of Ireland (GSI) (2003): 100,000 Scale Map Series, Sheet 17 - Geology of Shannon Estuary.

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.

COFORD, 2004: Forest Road Manual – Guidelines for the Design, Construction and Management of Forest Roads.

Coillte, 2009: Forest Operations & Water Protection Guidelines.

DoHLG, 2006: Wind Farm Development Guidelines for Planning Authorities.

EPA (2017) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports – Draft.

EPA (September 2015): Draft - Advice Notes on Current Practice (in the preparation on Environmental Impact Statements) where relevant.

EPA (September 2015): Draft – Revised Guidelines on the Information to be Contained in Environmental Impact Statements where relevant.

EPA, 2003: Advice Notes on Current Practice (in the preparation on Environmental Impact Statements) where relevant.

Forest Services (Draft, undated): Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures.

Forest Service, 2000: Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.

Forestry Commission, 2004: Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh.

IFI, 2016: Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters, Inland Fisheries Ireland (2016).

IGI, 2013: Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements, (Institute of Geologists Ireland, 2013).

NRA, 2005: Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes, (National Roads Authority, NRA, 2005).

PPG1 - General Guide to Prevention of Pollution (UK Guidance Note).

PPG5 – Works or Maintenance in or Near Watercourses (UK Guidance Note).

SNH, 2010: Scottish Natural Heritage report (SNH): Good Practice During Wind Farm Construction.

SNH, 2013: Scottish Natural Heritage report (SNH): Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms.

Air and Climate

Burck et al., 2020 Results 2020. Climate Change Performance Index. New Climate Institute, 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 (2004). Quarries and Ancillary Activities, Guidelines for Planning Authorities.

Department of the Environment, Heritage and Local Government (2006). Best Practice Guidelines on the Preparation of Waste Management Plans for Construction & Demolition Projects.

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. European Environment Agency, Denmark.

European Environment Agency (2018). Air Quality in Europe – 2018 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 (2008) Ambient Air Monitoring in Ennis 24th January 2006 to 18th April 2007

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.

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

Clare County Council (2017) Clare County Development Plan 2017-2023

Clare County Council (2004) Landscape Character Assessment of County Clare

Clare County Council (2017) Clare Wind Energy Strategy 2017-2023

Cumulative Impact of Wind Turbines on Landscape and Visual Amenity. Carmarthenshire County Council (2013)

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.

Department of the Environment and Local Government, 2000 Landscape and Landscape Assessment: Consultation Draft of Guidelines for Planning Authorities' DoEHLG, Dublin.

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.

The Landscape Institute/Institute of Environmental Management and Assessment, UK, (2013). Guidelines for Landscape and Visual Impact Assessment (

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.

Archaeological and Cultural Heritage

Aalen, F.H.A., Whelan, K. and Stout, M. (1997) Atlas of the Rural Irish Landscape. Cork University Press

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.

O'Riordain, Sean P. (1979) Antiquities of The Irish Countryside (5th edition revised by R. De Valera). London. Power, D. (ed.) (1992)

Stout, M. (1997) 'The Irish Ringfort'. Four Courts Press, Dublin

Waddell, J. (1998) The Prehistoric Archaeology of Ireland. Dublin

Material Assets

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.

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.