FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED ANNAGH WIND FARM, CO. CORK

VOLUME 1 – NON-TECHNICAL SUMMARY

Prepared for: EMPower

EMPower

Date: November 2021

Core House, Pouladuff Road, Cork
T12 D773, Ireland

T: +353 21 496 4133 E: info@ftco.ie

CORK | DUBLIN | CARLOW

www.fehilytimoney.ie

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1. INTRODUCTION

1.1 Site Description

Fehily Timoney & Company (FT) has prepared this environmental impact assessment report (EIAR) on behalf of Annagh Wind Farm Limited, a subsidiary of EMP Energy Limited (EMPower). Annagh Wind Farm Limited intends to apply to Cork County Council for planning permission to construct the proposed Annagh Wind Farm, near Charleville, County Cork. The proposed project consists of four main elements:

- Annagh Wind Farm;
- Turbine Delivery Route;
- Grid Connection Route;

The proposed Annagh Wind Farm turbines are located in an agricultural area in north County Cork, c. 6km south west of Charleville and c. 3km north of the village of Churchtown. The proposed Annagh Wind Farm development includes lands contained within the following townlands: Annagh North, Fiddane, Cooliney, Coolcaum. The proposed Grid Connection Route includes lands contained within the following townlands: Annagh North, Cooliney, Coolcaum, Rathnacally, Farranshonikeen, Ardnageehy and Clashganniv. The location of the proposed development is illustrated in Figure 1-1.

1.2 Development Description

The proposed Annagh Wind Farm will consist of up to 6 no. wind turbine generators, 1 no. meteorological mast, construction of new site tracks, the upgrade of existing agricultural tracks and 1 no. substation compound along with ancillary civil and electrical infrastructure.

The total Maximum Export Capacity of the proposed Annagh Wind Farm project is c. 37.2 Megawatts. The exact Export Capacity will be dependent on the output power of the turbine model available at procurement stage which is subject to technological advancements. The candidate turbine model is the Vestas V150. The proposed turbines will have the following specifications:

- Three bladed, horizontal axis type turbine;
- Height of 175m from the top of the foundation to blade tip height;
- Rotor diameter of 150m;
- Hub height of 100m.

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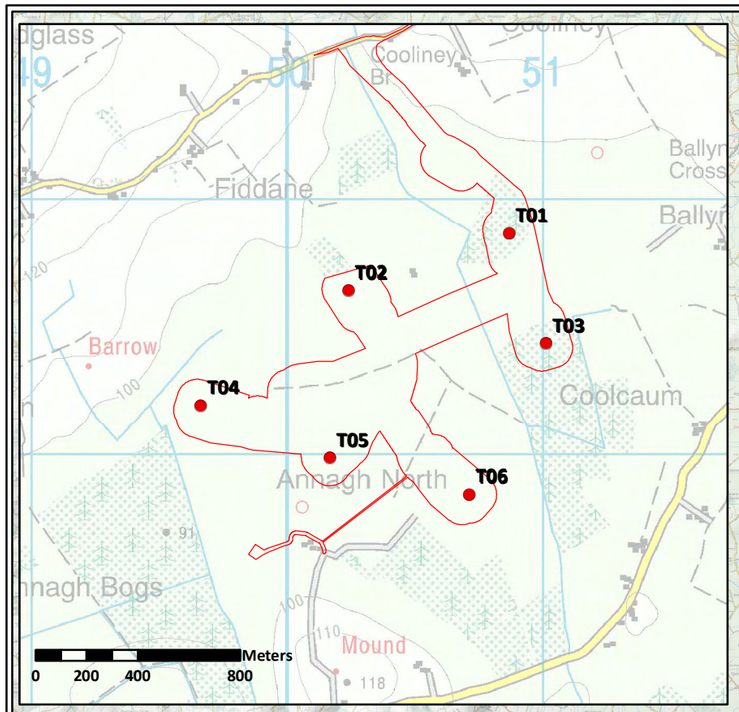

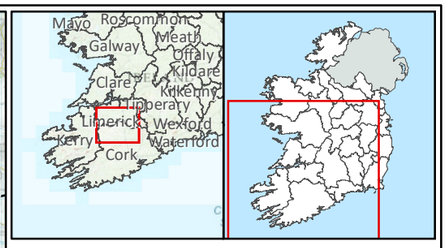

Legend

- County Boundaries
- Proposed Site Boundary
- Proposed Turbine Layout

0 2.5 5 10 Kilometers

TITLE: Site Location			
PROJECT: Annagh Wind Farm, Co. Cork			
FIGURE NO:	1.1		
CLIENT:	EMPower		
SCALE:	1:200000	**REVISION:**	0
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The associated grid connection cable will connect the on-site substation to the existing Charleville Substation within the townland of Rathnacally, County Cork. This will consist of 38kV cables and will be approximately 5.7km in length including 3.4km to be constructed primarily within the existing road corridor with 2.3km of underground cable to be laid within private lands within the proposed wind farm site.

Large components associated with the proposed Annagh Wind Farm construction will be transported to the wind farm site via the identified Turbine Delivery Route. It is proposed that turbine deliveries shall approach the site from the North via Foynes Port, the N69, the N18, the M20, the N20 and L1322. Temporary accommodating works will be required at selected locations along the Turbine Delivery Route to facilitate the delivery of large components to the site. The accommodation works associated with the Turbine Delivery Route is assessed in this report but does not form part of the proposed development for which permission is sought.

1.3 EIAR Structure

The EIAR has been prepared using the "grouped format structure" as outlined in Environmental Protection Agency's (EPA) guidance documents (EPA, 2002; EPA, 2003) and in line with the draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (2017). The format of this EIAR is designed to ensure that standard methods are used to describe all sections of the EIAR.

Using this structure there is a separate chapter for each topic, e.g. air quality and climate, biodiversity, hydrology. The description of the existing environment, the proposed development and the potential impacts, mitigation measures and residual impacts are grouped in the chapter. The grouped format makes it easy to investigate topics of interest and facilitates cross-reference to specialist studies.

The EIAR consists of the following chapters:

- Chapter 1 - Introduction
- Chapter 2 - Need for the Development and Alternatives Considered
- Chapter 3 - Description of the Proposed Development
- Chapter 4 - Policy
- Chapter 5 - EIA Scoping, Consultation and Key Issues
- Chapter 6 - Air Quality and Climate
- Chapter 7 - Noise and Vibration
- Chapter 8 - Biodiversity
- Chapter 9 - Land, Soils & Geology
- Chapter 10 - Hydrology and Water Quality
- Chapter 11 – Population, Human Health & Materiel Assets
- Chapter 12 – Shadow Flicker
- Chapter 13 - Traffic & Transportation
- Chapter 14 - Archaeology, Architectural and Cultural Heritage
- Chapter 15 - Landscape & Visual
- Chapter 16 - Telecommunications and Aviation
- Chapter 17 - Interactions of the Foregoing.

The EIAR is structured as follows:

Volume 1 – Non-Technical Summary
Volume 2 – Main EIAR
Volume 3 – Appendices to the Main EIAR
Volume 4 – Landscape and Visual Maps and Photomontages

Also included are:

- A separate Natura Impact Statement (NIS) has also been submitted with the application.
- An assessment of replant lands at Emlagh, County Clare
- The application is also supported by Planning Drawings and a Construction Environmental Management Plan

1.4 Permission Period

A ten-year consent is being requested for this development. That is, planning consent for the construction of the development would remain valid for ten years following the grant of permission. The applicant requests a grant of permission on the basis of a 35-year operational period from the date of commissioning of the wind farm.

1.5 Difficulties Encountered

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

2. NEED FOR THE DEVELOPMENT AND ALTERNATIVES CONSIDERED

2.1 The Need for the Proposed Development

The proposed Annagh Wind Farm is necessary to produce renewable energy for the Irish national grid in order to transition Ireland to a low carbon economy. The proposed wind farm has an estimated capacity of approximately 37.2 megawatts. The project will play a role in providing renewable electricity in the Republic of Ireland, accounting for c. 0.86% of the current installed wind energy capacity (Wind Energy Ireland, 2021).

At a strategic level, the need for the Project is supported by International, European, and National environmental and energy commitments and policies. In Chapter 4 of the EIAR, a detailed analysis of these commitments and policies is outlined. The Irish Government published the Climate Action Plan in June 2019 which sets actions to ensure Ireland's 2030 renewable energy targets can be achieved. This is in the context of substantial and continuing failure by Ireland in meeting climate targets to date.

The Climate Action Plan (2019) recognises that Ireland must make a significant increase in the current levels of renewable energy production in the country. A press release accompanying the Climate Action Plan (CAP), titled '*Giving Ireland a Sustainable Future*' (DoCCAE, 2019a) states that:

> "*We should be radically reducing our reliance on carbon; Ireland's greenhouse gas emissions have been rising rapidly. We are currently 85% dependent on fossil fuels. We have a short window of opportunity to reverse this trend and secure a better, healthier, more resilient future for the country…This plan identifies how Ireland will achieve its 2030 targets for carbon emissions and puts us on a trajectory to achieve net zero carbon emissions by 2050.*"

The Climate Action Plan (2019) sets a target to produce 70% of Ireland's electricity production from renewable sources by 2030. The proposed Annagh Wind Farm will provide approx. 37.2 megawatts of renewable electricity to the national grid. The increase in domestic renewable energy as a result of the Annagh Wind Farm will also assist Ireland in improving resilience in energy security by reducing the requirement for import of fossil fuels.

2.2 Alternatives Considered

The alternatives considered have particular regard to the environmental considerations which influenced the selection of alternatives and details the evolution of the proposed project through alternatives considered, indicating the main reasons for selecting the chosen option taking into account the effects of the proposed project on the receiving environment and considering the comparison of environmental effects of each alternative.

The alternatives considered have been described in line with the draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (2017).

Do-Noting Scenario

Under the "Do-Nothing" scenario, the Annagh Wind Farm project would not go ahead, the development of a renewable energy project is not pursued, and the site remains in use as agriculture and forestry and the prospect of creating sustainable energy through County Cork's wind energy resource would be lost at this site.

The nation's ability to produce sustainable energy and reduce greenhouse gas emissions to meet EU targets and National targets, as set out above, would be stifled. This may result in the nation incurring significant financial penalties from the EU if targets are not achieved. The "Do-Nothing" scenario may result in continued global warming and impact upon the intention to "pursue efforts" to limit warming as agreed to in the Paris Agreement (2015). Issues in securing a reliable supply of energy may arise due to Ireland's over-reliance on imported fossil fuels and plans to cease the burning of coal at Moneypoint and peat burning at Bord na Móna's powerplants by 2023.

Alternatives Considered

The site selection process considered the following criteria: Wind Speeds available; Planning Policy, Landscape Designations, Proximity to existing grid connection points; Airport proximity; Existing electrical generation, grid upgrades and electrical loads in the area; Environmental designations and sensitivities; Existing planned and permitted projects; Tourism amenity; Cultural Heritage sites, Topography; Access route availability; Water bodies; Land use and number of landowners. A number of sites were considered for a wind energy development, however, the Annagh site was found to be optimal for a wind energy development, considering the criteria above.

Alternative layouts for the proposed project considered the following criteria: Set back from houses; Set back from designated sites; Set back from other constraints such as watercourses, public roads and power lines; Suitable wind speeds; Landscape and visual sensitivity; Ecology; Ornithology; Soils and Geology; Hydrology; Noise; and Cultural Heritage. Five separate design iterations were produced in the development of the proposed project, which considered different numbers of turbines and a range of different turbine heights.

Five different substations were considered for a potential connection to the national grid. Following an assessment, the Charleville 110kV Substation was selected as the optimal connection point due to less environmental sensitivities. Three3 alternative grid routes were considered between the proposed wind farm site and the Charleville Substation. The least environmentally sensitive option was chosen.

The alternatives considered throughout the development process of the proposed Annagh Wind farm aimed to minimise the potential impact on the receiving environment while providing significant renewable electricity production to the national grid.

3. DESCRIPTION OF PROPOSED DEVELOPMENT

3.1 Proposed Development

The proposed project assessed in the EIAR is comprised of the following key elements and is illustrated in Figure 3-1, below:

- The Wind Farm Site ('the Site');
- The Grid Connection Route
- The Turbine Delivery Route

The Site includes the wind turbines, internal access tracks, hard standings, permanent meteorological mast, on-site substation, internal electrical and communications cabling, temporary construction compound, drainage infrastructure and all associated works related to the construction of the wind farm. Refer to Figure 3-2 for the general arrangement of the Site. The Site includes lands in the townlands of Annagh North, Fiddane, Cooliney, Coolcaum.

The Grid Connection Route runs from the proposed on-site substation to the existing Charleville 110kV substation, passing through the townlands of Annagh North, Coolcaum, Cooliney, Rathnacally, Farranshonikeen, Ardnageehy and Clashganniv. The Grid Connection Route is illustrated in Figure 3-3, below.

The Turbine Delivery Route passes through the townlands of Cooliney, Rathnacally, Farranshonikeen, Ardnageehy, Clashganniv, Ballyhea before it enters the national primary road network at the N20 between Ballyhea and the Port of Foynes, County Limerick. The turbine delivery route is illustrated in Figure 3-4, below.

Replant lands located at Emlagh, near Moyasta, County Clare have been assessed for potential cumulative impacts throughout the EIAR.

In summary the proposed project will consist of the following:

- Erection of 6 no. wind turbines with a blade tip height of 175m, rotor diameter of 150m and a hub height of 100m;
- Construction of turbine foundations and crane pad hardstanding areas;
- Construction of new site tracks and associated drainage infrastructure;
- Upgrading of existing tracks and associated drainage infrastructure where necessary;
- Upgrade of existing entrance onto Local Road L1322;
- All associated drainage and sediment control including the installation of new watercourse or drain crossings and the re-use or upgrading of existing internal watercourse and drain crossings;
- Construction of 1 no. permanent onsite 38kV electrical substation to ESBN specifications including:
    - Control Building with welfare facilities;
    - Electrical infrastructure;
    - Parking;
    - Wastewater holding tank;
    - Rainwater harvesting;

  - Security fencing;
  - All associated infrastructure, services and site works.
- Temporary accommodation works associated with the Turbine Delivery Route to facilitate the delivery of turbine components;
- 1 no. Temporary construction site compound and associated ancillary infrastructure including parking;
- Tree felling and associated replanting to facilitate construction and operation of the proposed development;
- Installation of underground medium voltage (20/33kV) and communication cabling between the proposed turbines and the proposed on-site substation and associated ancillary works;
- Erection of 1 no. permanent meteorological mast with a height of 100m above ground level and associated access track;
- Installation of medium voltage (up to 38kV) underground cabling between the proposed on-site substation and the existing Charleville substation and associated ancillary works. The proposed grid connection cable works will include 2 no. watercourse crossings and the installation of 9 no. pre-cast joint bays;
- All associated site development works;
- A 10 year planning permission and 35 year operational life from the date of commissioning of the entire wind farm.

A permanent onsite electricity substation will be constructed within the proposed wind farm site which will provide a connection point between the wind farm and the proposed grid connection point at the existing Charleville Substation.

3.2 Wind Turbines

The proposed turbines will have a tip height of 175m, 100m hub height and a rotor diameter of 150m. The proposed turbine model is the Vestas V150. The wind turbines that will be installed on site will be conventional three bladed, tubular tower model with horizontal axis. The rotor blades are bolted to the central hub, which is connected to a generator located in the nacelle. The nacelle holds the following turbine components:

- Generator;
- Electrical components;
- Control unit.

A glass fibre reinforcing polyester hood covers the nacelle. Earthing and isolation protect all components from lightning strikes.

3.3 Turbine Transport

Large components associated with the wind farm construction will be transported to site via the identified Turbine Delivery Route. The proposed access route to site is as follows:

- Loads will depart the Port of Foynes and turn left onto the N69 towards Limerick;
- Loads will travel onto the N18 and turn onto the M20/N21;
- Loads will turn onto the N20 and travel south through the town of Charleville
- The route then turns onto the L1322 local road at Ballyhea; and,
- The route continues westwards on the L1322 for c.4km before entering the proposed wind farm site.

3.4 Drainage

The drainage system will be constructed alongside all turbine hardstands, internal access tracks, substation and the temporary construction compound. The drainage system for the existing tracks and field boundaries will be retained. Where the roads require widening, this will involve the re-location of existing roadside swales to allow for widening.

Further details on hydrology and drainage are contained within the CEMP and in the Planning Drawings. The number of stilling ponds and their locations are shown on the planning drawings accompanying this application for consent.

3.5 Construction Phase

The construction sequence is expected to take between 12 – 18 months, and will be as follows. Tree felling, upgrading of existing site tracks and the provision of new site tracks will precede all other activities. Drainage infrastructure will be constructed in parallel with the track construction. This will be followed by the construction of the turbine hardstanding areas and foundations, the on-site electrical works i.e. the sub-station and internal cable network as well as off-site connection works to the national grid will be completed.

Prior to construction works, clearance felling will commence on site and is expected to take up to 2 months. Felling will consist of approximately 12.6 hectares of broadleaf forestry which will be replanted off-site at Emlagh, County Clare. The felling area proposed is the minimum necessary to construct the proposed project and comply with any environmental mitigation. The felling will be the subject of a Felling Licence Application to the Forest Service prior to construction as per the Forest Service's policy on granting felling licenses for wind farm developments.

The drainage system for the existing tracks and roads will largely be retained. It is proposed to upgrade c. 0.38km of existing agricultural tracks on the approach to the proposed substation. All track widening will be undertaken using clean uncrushable stone with a minimum of fines. This will involve tree felling and hedge trimming and the upgrade of existing roadside ditches to allow widening.

There is a single river crossings proposed within the wind farm site. This will consist of a single-span bridge. The bridge will house ducts within its deck to accommodate the grid connection cable.

The grid connection crosses another stream within the public road. Here, horizontal directional drilling will be used to install the cable beneath the stream.

For cable trenches located in public roads, the contractor will excavate cable trenches and then lay high density polyethylene (HDPE) ducting in the trench in a surround of cement bound material. A rope will be inserted into the ducts to facilitate cable-pulling later.

The as-constructed detail of the cable duct locations will be carefully recorded. Cable marker strips will be placed above the ducts and the two communication ducts will also be laid. An additional layer of cable marker strips will be laid above the communication ducts and the trench back-filled. Back-filling and reinstatement in public roads will be to a specification to be agreed with the road authority.

A similar construction methodology will apply for cable trenches laid within site access tracks. In this case the cable-ducts will generally be laid when the track is being constructed and will follow the edge of the site access tracks. The trenches within these locations will generally be backfilled using the excavated material.

3.6 Operation, Maintenance and Decommissioning/Reinstatement

The expected physical lifetime of the turbine is approximately 35 years, and permission is sought for a 35-year operation period commencing from full operational commissioning of the wind farm.

During the operation of the project some maintenance work may be required for the turbines and underground cabling. It will require maintenance and operations crews to tend to the site periodically throughout the lifetime of the project. It is unlikely that works will be required along the grid connection route during the operational phase unless maintenance is required. It is unlikely that the turbine delivery route will be used during the operational phase unless replacement or maintenance of turbine components is required.

On decommissioning, cranes will disassemble the above ground turbine components which would be removed off site for recycling. All the major component parts are bolted together, so this is a relatively straightforward process. The foundations will be covered over and allowed to re-vegetate naturally. Leaving the turbine foundations in situ is considered a more environmentally sensible option as to remove the reinforced concrete associated with each turbine would result in environmental nuisances such as noise and vibration and dust. It is proposed that the internal site access tracks will be left in place.

Grid connection infrastructure including substations and ancillary electrical equipment shall form part of the national grid and will be left in situ.

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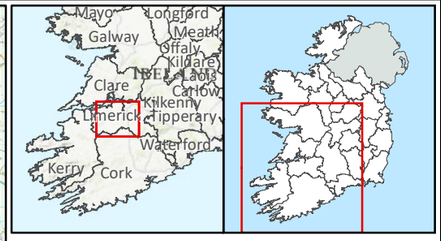
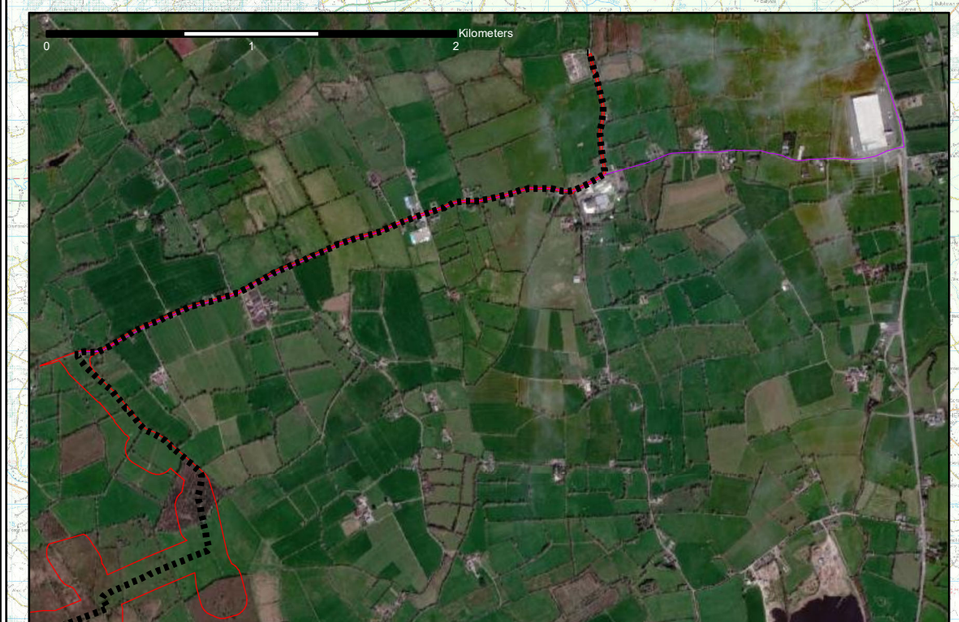


Legend

- Proposed Wind Farm Site
- Turbine Delivery Route
- Underground Cable Route



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DATE:	12/10/2021	**PAGE SIZE:**	A3

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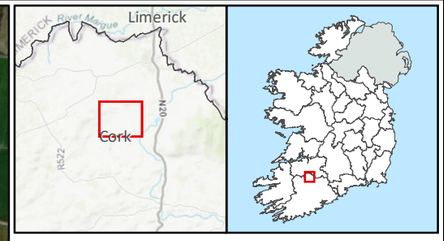

Legend

- Site Boundary
- Turbine Layout
- Met Mast
- Underground Cable Route
- Substation
- Construction Compound
- Turbine Hardstanding
- Turning Heads

Roads

- New
- Upgrade

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TITLE: Wind Farm Site Layout			
PROJECT: Annagh Wind Farm, Co. Cork			
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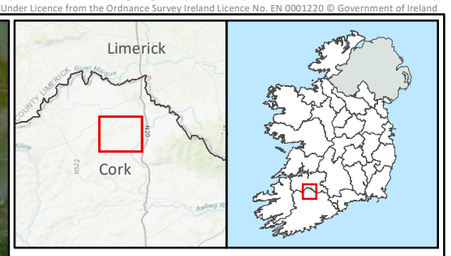

Legend

- Site Boundary
- Turbine Layout
- Underground Cable Route
- Construction Compound
- Substation
- Special Area of Conservation (SAC)

N W E S

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TITLE:	Grid Connection		
PROJECT:	Annagh Wind Farm, Co. Cork		
FIGURE NO:	3.3		
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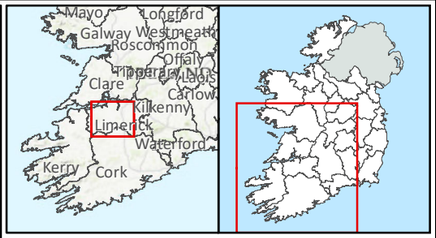
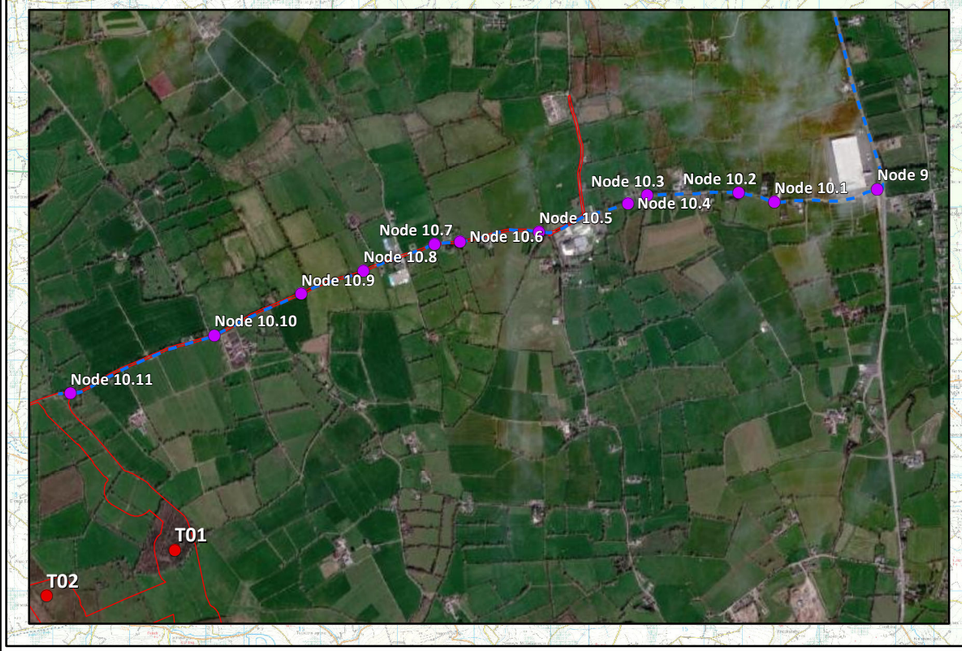


Legend

- Site Boundary
- Turbine Layout
- TDR Nodes
- Turbine Delivery Route



TITLE: Turbine Delivery Route			
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FIGURE NO:	3.4		
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4. POLICY AND LEGISLATION

4.1 EU Directives and Policies

The section details the latest policies and targets with a view to 2030 and beyond. The various directives and policies of the EU set a clear mandate for each member state to transition to sustainable, renewable energy and reduce greenhouse gas emissions.

Relevant international policies in relation to renewable energy and the need to prevent climate change include the United Nations Framework Convention on Climate Change and the Kyoto Protocol.

EU Directives and Policies include:

- 2030 Climate and Energy Framework
- A Roadmap for Moving to a Competitive Low Carbon Economy in 2050
- Clean Energy for all Europeans Package (2019)
- Recast Renewable Energy Directive (RED2)
- European Green Deal (December 2019).

Relevant National Policies:

- Climate Action and Low Carbon Development Act 2015
- Climate Action and Low Carbon Development (Amendment) Act 2021
- Climate Action Plan (2019) and recently updated in 2021.
- EU Governance Regulation and Ireland's National Energy and Climate Plan (NECP)
- Project Ireland 2040: The National Planning Framework
- Project Ireland 2040: National Development Plan 2021 – 2030
- Ireland's Greenhouse Gas Emission Projections, 2018 – 2040
- National Policy Conclusion.

Regional and Local plans have also been considered including the Cork County Development Plan 2014 and the Draft County Development Plan (2021), which sets out the wind energy strategy for the county. Lands located within the wind farm development are identified as being 'open for consideration' for wind energy development.

The proposed development contributes to the nation's target increase of renewable energy from 30% to 70% by 2030 and supports the doubling of onshore wind energy in Ireland by 2030 as set out in the Climate Action Plan.

4.2 Irish Energy & Environment Policies

The development of the proposed Annagh Wind Farm is in support of national policy. The project supports the enhancement of the competitiveness of rural areas and facilitates the development and diversification of the rural economy by supporting the energy sector and increasing the share of renewables in Ireland's energy mix.

The proposed development contributes to the nation's target increase of renewable energy from 30% to 70% by 2030 and supports the doubling of onshore wind energy in Ireland by 2030 as set out in the Climate Action Plan.

The project supports national targets of climate change mitigation and reduction in greenhouse gas emissions where significant focus has been set out in the recent Climate Action and Low Carbon Development (Amendment) Act 2021. The ambitious new programme for government is prioritising carbon neutrality and renewable energy generation. In light of this, it is important for the nation to rely on proven technologies such as on shore wind in order to meet the near-term objectives, as well as long-term objectives.

The proposed project promotes the generation of renewable energy at appropriate locations and supports the achievement of a low carbon economy by 2050. It is therefore considered that the proposed Annagh Wind Farm is in line with national policy and supports the achievement of national energy and sustainability targets.

4.3 Cork County Development Plan

It is a specific planning policy requirement under Section 28 of the Planning & Development Act 2000 (as amended) that in making development plans a planning authority has regard to national policy on renewable energy as contained in the aforementioned policy documents. A County Development Plan is required to indicate how the implementation of the development plan will contribute to realising overall national targets on renewable energy and climate change mitigation. This applies in particular to wind energy production and the potential wind energy resource.

The Cork County Development Plan (CDP) 2014 sets out the strategic framework for land use planning in the county. Chapter 9 of the CDP sets out the energy strategy for the County with an aim to:

> *"Ensure that through sustainable development County Cork fulfils its optimum role in contributing to the diversity and security of energy supply and to harness the potential of the county to assist in meeting renewable energy targets."* (ED 1-1 Energy)

The most pertinent transposed policies and objectives are outlined below:

Policy / Objective	Description
Objective ED 3-1	National Wind Energy Guidelines - Development of on-shore wind shall be designed and developed in line with the 'Planning Guidelines for Wind Farm Development 2006" issued by DoELG and any updates of these guidelines.
Objective ED 3-2	Wind Energy Projects - On-shore wind energy projects should focus on areas considered 'Acceptable in Principle' and Areas 'Open to Consideration' and generally avoid "Normally Discouraged" areas in this Plan.

Policy / Objective	Description
Objective ED 3-3	Wind Energy Generation - Support a plan led approach to wind energy development in County Cork and identify areas for wind energy development. The aim in identifying these areas is to ensure that there are no significant environmental constraints, which could be foreseen to arise in advance of the planning process.

The Cork County Development 2014 is currently under review. The draft County Development Plan 2022-2028 was published in April of 2021. The plan is subject to public consultation, prior to its expected adoption in 2022.

5. EIA SCOPING & CONSULTATION

5.1 Purpose of EIA scoping

The purpose of the EIA scoping process is to identify the key points and issues which are likely to be important during the environmental impact assessment (EIA) and to eliminate those that are not. This is conducted by preparing a report detailing the proposed development and sending it to a list of consultees such as various governmental departments, non-governmental organizations, environmental bodies, interested parties and key stakeholders, including telecommunication companies and aviation authorities which operate in the area of the Annagh Wind Farm.

A scoping request was sent to relevant parties on the 22nd of September 2020. The scoping process proved beneficial to the identification of potential issues in relation to the proposed Annagh Wind Farm, and identified a range of observations which have been taken into consideration in the preparation of the respective chapters of the EIAR.

The scoping response received from Cork County Council Planning Department advised on engaging in a pre-planning meeting with the Planning Department. Furthermore, relevant and best practice guidelines for the EIAR compilation process was recommended.

Observations and issues that arose during the scoping and consultation process have informed the design, assessment and mitigation measures proposed as part of this project.

5.2 Key Issues

Cork County Council advised on ten key issues which required consideration in an EIAR. These points include locating the Annagh Wind Farm at another location as a 'Reasonable Alternative' due to the proposed site's location relative to designated sites and CDP 2014 Wind Energy Policy. The 'Cumulative impact' of the proposed development with other existing or approved wind farm developments in the area was also considered. The site appears to be partially within a protected European site, so any impact on biodiversity must be considered and an Appropriate Assessment (AA) should be undertaken to assess the possible implications of the development on the protected site.

Further assessments are required to assess the land and soils within the site to establish the nature of its ground conditions and its suitability as a site of a wind farm. Assessments must include geotechnical assessments, geological assessments, hydro-geological investigations to assess any bog burst or landslide hazard, groundwater contamination and further assessments of any borrow-pits and if dewatering will apply, vibration impact assessment, borrow pit reinstatement, geotechnical analysis for turbine bases, method of excavations and hydrology. Further specific Hydrology assessments will be required to assess the water on site, and evaluate the drainage and flood risk associated with the development. The impact on the local road network also requires consideration to facilitate construction related traffic and effects on the local residents, with further consideration to the scale, height and layout of scheme and its infrastructure and dimensions in relation to the receiving landscape.

The site and receiving environment entail a number of landscape character types and a high value landscape located to the east of the site which will require the highest standards of siting and design for a wind energy development.

In conjunction with the landscape considerations, construction practice on site will be considered in relation to the disposal or elimination of waste/surplus material from construction/site clearance, which should include details of the proposed grid connection and the most likely corridor of grid connection and associated works, with decommissioning of the site also addressed.

In the pre-planning meeting with Cork County Council, their representative recommended a Construction Environmental Management Plan (CEMP) be submitted and include details of quarries, borrow pits remedial works and mitigation. It was also advised that all environmental assessment be conducted in line with best practice guidelines, for each respective environmental topic. Cork County Council also recommended a number of departments to contact for feedback including the County Council Archaeologist, Ecologist and Area Engineer. These County Council departments were contacted with a copy of the pre-planning presentation following the meeting.

Community consultation events were also organized, with community engagement conducted by members of the development team who acted as the Community Liaison Officers (CLOs), who also created a project website to provide information and advertise consultation dates. The consultations raised awareness of the project in the local community, created engagement with individuals in the area, allowed distribution of project information and updates, and invited feedback from the public. These public engagements included in-person and on-line consultations such as a Community Information Event in October 2019, and three online webinars in December 2020, March 2021 and September 2021.

The main issues which arose during the public consultation process were associated with visibility, access and the Community Benefit Fund. The issue regarding visibility concerned the potential visual impact of the proposed project, and included enquiries on the setback distance to nearby dwellings, the number of turbines that would be visible from specific dwellings and potential for cumulative visual impact of the proposed development in combination with the existing Boolard and Rathnacally wind turbines. The second issue regarding access was due to concerns regarding the site access point and nearby dwellings and the potential issue of noise, vibration and dust during the construction phase, with the third issue focusing on the community benefit fund associated with the project, and what type of offering would be made available and how it would be distributed throughout the community.

Observations and issues that arose during the scoping and consultation process have informed the design, assessment and mitigation measures proposed as part of this project as set out throughout this EIAR.

6. AIR QUALITY AND CLIMATE

European air quality legislation requires that each member state be defined in terms of Zones and Agglomerations for air quality, with Ireland divided into four zones. The EPA has designated four zones within Ireland :

- Zone A: Dublin City and its environs
- Zone B: Cork City and its environs
- Zone C: 24 cities and towns (such as Galway, Limerick and Waterford cities and towns such as Naas, Newbridge, Celbridge, Leixlip) with a population of greater than 15,000
- Zone D covers the 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 proposed wind farm and grid connection are located in Zone D. The majority of the Turbine Delivery Route is in Zone D. A short section of the Turbine Delivery Route is in Zone C where the route takes the N18, south of Limerick City.

The air quality in each zone is monitored by the EPA and classified with respect to upper and lower assessment thresholds based on measurements over the previous five years. The number of monitoring locations required is dependent on population size and whether ambient air quality concentrations exceed the upper assessment threshold, are between the upper and lower assessment thresholds, or are below the lower assessment threshold.

An assessment of air quality was carried out in Limerick City from 26th January 2000 – 13th November 2000. The monitoring assessment at Limerick City is the closest site to the application site and provides an environmental baseline of air quality conditions in the region. A summary of findings for sulphur dioxide, Particulate Matter (PM10), Nitrogen Dioxide (NO2) and Carbon Monoxide (CO) is found in the following sections.

6.1 Potential Impacts

6.1.1 Do-nothing scenario

If the proposed wind farm does not proceed, local air quality and the microclimate will remain unchanged. On a national scale, there will be an increase in greenhouse gas emissions if increasing future electricity needs are not met by alternative renewable sources which has the potential to contribute to air pollution and climate change. The opportunity to contribute to Ireland's commitments under the Kyoto Protocol and to meet national targets as set out in the Climate Action Plan (2019) would also be lost.

6.1.2 Construction Phase

The principal sources of potential air emissions during the construction of the proposed project will be from the wind farm and grid connection route; from dust arising from earthworks, tree felling activities, trench excavation along cable routes, construction of the new and upgrade of existing access tracks, the temporary storage of excavated materials, the movement of construction vehicles, loading and unloading of aggregates/materials and the movement of material around the site.

Dust emissions arise when particulate matter becomes airborne making it available to be carried downwind from the source. The amount of dust generated and emitted from a working site and the potential impact on the surrounding areas varies according to:

- The type and quantity of material and working methods;
- Distance between site activities and sensitive receptors;
- Climate/local meteorology and topography.

The overall construction of the proposed wind farm is considered a major construction site, as it will result in soiling effects which have the potential to occur up to 100m from the source. The nearest receptor is 690m from the proposed turbine locations where the majority of the proposed works will take place, therefore nearby dwellings will not experience the soiling, deposition or vegetation effects. Construction vehicles and plant emissions have the potential to increase concentrations of compounds such as NO2, Benzene and PM10 in the receiving environment. Due to distance between the nearest receptor and source of emissions the impact from these emissions will be Imperceptible.

The construction of the proposed grid connection route is considered a moderate construction site as it will result in soiling effects which have the potential to occur up to 50m from the source, with PM10 deposition and vegetation effects occurring up to 15m from the source. There are approximately 30 one-off houses along the 3.3 km stretch of public road where the proposed grid connection is located. Some houses may experience soiling and deposition of vegetation effects depending on how close to the road corridor they are located.

Construction vehicles and plant emissions have the potential to increase concentrations of compounds such as NO2, Benzene and PM10 in the receiving environment. However, due to the nature of construction along the proposed grid connection, which works as a “rolling” construction site, meaning that these works will not be concentrated in any one area of the route for a prolonged period, these effects are considered to be short term, temporary and slight.

It is not predicted that an air quality impact will occur due to traffic at the proposed wind farm as the impacts will fall below the screening criteria set out in the UK DMRB guidance (UK Highways Agency 2007), on which the TII guidance is based.

On the surrounding road network, there will be an average daily increase of 53 HGV trips per day over a construction period of 12 months and 5 HGV trips per day for the construction of the grid connection. LGV traffic is expected to be 34 trips per working day on average for the wind farm site over a 12-month period and 2 trips per day for the grid connection. The combined HGV and LGV average daily increase is 88 trips per day. Therefore, the model is not required in this instance.

Plant and machinery such as generators, excavators etc. will be required at various stages of the construction works. These will be relatively small units which will be operated on an intermittent basis. Although there will be an emission from these units, given their scale and the length of operation time, the impacts of emissions from these units will be imperceptible.

6.1.3 Operational Phase

Once the proposed wind farm and grid connection are constructed there will be no significant direct emissions to atmosphere. A diesel generator will be located at the proposed wind farm substation; however, this will only be operated as a back-up/emergency power supply. Emissions from the diesel generator will therefore be infrequent. During use, a diesel generator will emit carbon dioxide, nitrogen oxide and particulate matter, however, due to the low usage, the impact will be imperceptible.

Maintenance vehicles will access the proposed wind farm site during the operational period, however, due to the low traffic movements involved, the impact will be imperceptible. The operational phase of the wind farm will result in positive impacts on air quality due to the displacement of fossil fuels as an energy source.

6.1.4 Decommissioning Phase

During the decommissioning phase, there will be truck movements associated with removing the wind turbines from the wind farm resulting in vehicular emissions and also dust. However, the number of truck movements would be significantly less than the construction phase and would potentially result in a slight temporary impact. There will also be emissions from machinery on site including for the movement of soil to cover the foundations, however, this is not likely to result in significant impacts.

During the decommissioning phase, the proposed grid connection infrastructure including substations and ancillary electrical equipment will form part of the national grid and shall be left in situ. The internal ducts of the proposed project, and all internal access roads, turbine hardstanding's will be left in situ, resulting in no additional truck movements and no impact from emissions from machinery along the grid connection route.

6.2 Mitigation Measures

During the construction phase, a Construction Environmental Management Plan (CEMP) has been prepared, which includes the following mitigation measures during the construction phase of the proposed wind farm relevant to air quality:

- The internal access roads will be constructed/upgraded prior to the commencement of other major construction activities. These roads will be finished with graded aggregate;
- A water bowser will be available to spray work areas (wind turbine area and grid connection route) and haul roads, especially during periods of excavations works coinciding with dry periods of weather, in order to suppress dust migration from the site;
- All loads which could cause a dust nuisance will be covered to minimise the potential for fugitive emissions during transport;
- Gravel will be used at the site exit point to remove any dirt from tyres and tracks before travelling along public roads;
- Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.

- The access and egress of construction vehicles will be controlled to designated locations, along defined routes, with all vehicles required to comply with onsite speed limits;
- Construction vehicles and machinery will be serviced and in good working order;
- Wheel washing facilities will be provided at the entrance/exit point of the proposed wind farm site;
- The developer in association with the contractor will be required to implement a dust control plan as part of the CEMP (In the event the Planning Authority decides to grant permission for the proposed wind farm, the final CEMP will address the requirements of any relevant planning conditions, including any additional mitigation measures which are conditioned by the Planning Authority.
- Receptors which receive dusting and soiling from local routes entering the site; and dwellings directly adjacent to the grid connection route construction that experience dust soiling, where appropriate, and with the agreement of the landowner, will have the facades of their dwelling cleaned if required should soiling have taken place;
- Ensure all vehicles switch off engines when stationary – no idling vehicles; and
- Exhaust emissions from vehicles operating within the site, including trucks, excavators, diesel generators or other plant equipment, will be controlled by the contractor by ensuring that emissions from vehicles are minimised through regular servicing of machinery.

Over the lifetime of the proposed wind farm, the operation of the wind farm will have positive impacts on air quality, as such, mitigation measures are considered unnecessary for the operational phase.

Mitigation measures for the removal of wind turbines from the proposed project site will be similar as per the construction phase with respect to dust control and minimisation. The proposed access tracks across the proposed wind farm site will be left in situ and utilised as agriculture and forest roads following decommissioning and no mitigation measures are proposed. In terms of the underground grid cable, this will be left in situ and so no mitigation measures are proposed.

7. NOISE AND VIBRATION

The proposed Annagh Wind Farm is located within a rural environment, in an area comprising mostly of agricultural activities. Noise will be generated through construction activities at the wind farm site, grid connection and turbine delivery route. Nosie will also be produced by vehicles associated with the construction phase. Nosie will be generated during the operational phase by the rotation of the wind turbine blades as they generate electricity. Nosie will also be generated during the decommissioning phase of the proposed development. These potential effects will be similar to those of the construction phase. Nosie sensitive locations were identified in proximity to the proposed wind farm site. These are illustrated in Figure 7-1.

7.1 Potential Impacts

Baseline noise monitoring was undertaken at ten receptor locations surrounding the proposed Annagh Wind Farm to establish the existing background noise levels in the vicinity of the proposed development. These are some of the closest locations to the proposed development as well as representing different noise environments in the vicinity of the proposed development. Nosie monitoring locations are illustrated in Figure 7-2.

7.1.1 Construction Phase

Noise predictions were undertaken to determine the likely impact during the construction works due to activities such as site traffic, preparation of access roads, hardstands, drainage and wind turbine foundations and the instillation of the turbines, construction of the substation and grid connection works. The noise predictions have been carried out using International Standard “ISO 9613, Acoustics – Attenuation of Sound during Propagation Outdoors”. The model described in Part 2 of this standard provides for the prediction of sound pressure levels based on either short-term downwind (i.e. worst case) conditions or long-term overall averages.

Only the worst-case downwind condition has been considered in this assessment, that is – for wind blowing from the proposed turbines towards the nearby houses. When the wind is blowing in the opposite direction noise levels may be significantly lower, especially where there is any shielding between the turbines and the houses. The predicted noise levels from on-site activity from the proposed project is below the noise limits in BS 5228-1:2009+A1:2014. Nonetheless, several mitigation measures will be employed to minimise any potential impacts from the proposed project.

The noise impact for construction works traffic will be mitigated by generally restricting movements along access routes to the standard working hours and exclude Sundays, unless specifically agreed otherwise. For example, during turbine erection, an extension to the working day may be required, i.e. 05:00 to 21:00, but this would be necessary only on a relatively small number of occasions. If turbine deliveries are required at night, it will be ensured that vehicles on local roads do not wait outside residential properties with their engines idling, and that the local residents will be informed of any activities likely to occur outside of normal working hours.

Construction activities at the wind farm site are predicted to be below noise limits at nearby residential dwellings. These impacts are expected to be slight impact and temporary in duration.

There is potential for elevated noise levels due to the grid connection works resulting in a temporary significant impact. However, these works will be for a short duration at a particular property (i.e. typically less than 3 days at any particular receptor) and where the works are to occur over an extended period at a given location, a temporary barrier or screen will be used to reduce noise level below the noise limit and reduce any potential impact resulting in a moderate short-term residual impact.

7.1.2 Operational Phase

Noise predictions have been carried out using International Standard ISO 9613, *Acoustics – Attenuation of Sound during Propagation Outdoors*. The propagation model described in Part 2 of this standard provides for the prediction of sound pressure levels based on either short-term downwind (i.e. worst case) conditions or long-term overall averages.

Only the worst-case downwind condition has been considered in this assessment, that is – for wind blowing from the proposed turbines towards the nearby houses. When the wind is blowing in the opposite direction noise levels may be significantly lower, especially where there is any shielding between the turbines and the houses.

The predicted noise levels from the proposed project are below the daytime and night-time noise levels except at one dwelling (receptor R167) during daytime periods at a wind speed of 6 m/s. The predicted cumulative noise levels for the proposed Annagh Wind Farm in combination with the existing Boolard and Rathnacally Wind Farms have also been predicted. The cumulative noise levels comply with the daytime and night-time limits at the majority of noise sensitive locations. However, an exceedance is observed at receptor R167 during daytime periods at standardised 10m height wind speeds of 6 m/s. Mitigation measures are outlined to reduce noise impact at this location during these conditions.

7.1.3 Decommissioning Phase

Decommissioning activities will be undertaken during daytime hours, and noise, which will be of a lesser impact than for construction, will be controlled through the relevant guidance and standards in place at the time of decommissioning. Significant impacts from noise are not expected during decommissioning.

7.2 Mitigation Measures

The noise impact for construction works traffic will be mitigated by restricting movements along access routes to the standard working hours and exclude working on Sundays, unless specifically agreed otherwise with the local authority. The decommissioning works, which will be of a lower impact than construction works, will be carried out in accordance with the policies and guidance required at the time of the works, and restricted to normal working hours, 07:00 - 19:00 hours Monday to Friday and 07:00 - 13:00 on Saturdays in accordance with best practice.

Consultation with the local community is important in minimising the impacts and therefore construction will be undertaken in consultation with the local authority as well as the residents being informed of construction activities through the Community Liaison Officer.

At the proposed Grid Connection, where the works at elevated noise levels are required over an extended period at a given location, a temporary barrier or screen will be used to reduce noise levels below the noise limit where required. The noise impact will also be minimised by limiting the number of plant items operating simultaneously where reasonably practicable.

To ensure the proposed wind farm is compliant with the daytime noise limit at receptor R167, some of the turbines will operated in noise reduced modes of operation. Following mitigation, it is likely that there will be moderate significance of impact as a result of noise on the closest dwellings to the proposed wind farm during the operational phase as a result of a new source of noise being introduced into the soundscape.

During the decommissioning phase the noise impact for construction works traffic will be mitigated by restricting movements along access routes to the standard working hours and exclude working on Sundays, unless specifically agreed otherwise with the local authority.

The decommissioning works, which will be of a lower impact than construction works, will be carried out in accordance with the policies and guidance required at the time of the works, and restricted to normal working hours, 07:00 - 19:00 hours Monday to Friday and 07:00 - 13:00 on Saturdays in accordance with best practice.

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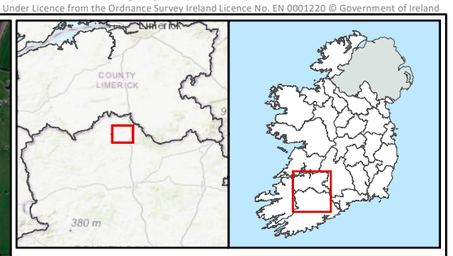

Legend

- Site Boundary
- Turbine Layout
- Met Mast
- Turbine Layout 700m Buffer
- Turbine Layout 1.5km Buffer
- Turbine Delivery Route
- Underground Cable Route
- Substation
- Construction Compound
- Turbine Hardstanding Area

Roads

- New
- Upgrade

Noise Sensitive Locations

- Residential
- Commercial
- Mixed Use

TITLE: Noise Sensitive Locations within Study Area			
PROJECT: Annagh Wind Farm, Co. Cork			
FIGURE NO:	7.1		
CLIENT:	EMPower		
SCALE:	1:25000	**REVISION:**	0
DATE:	12/10/2021	**PAGE SIZE:**	A3

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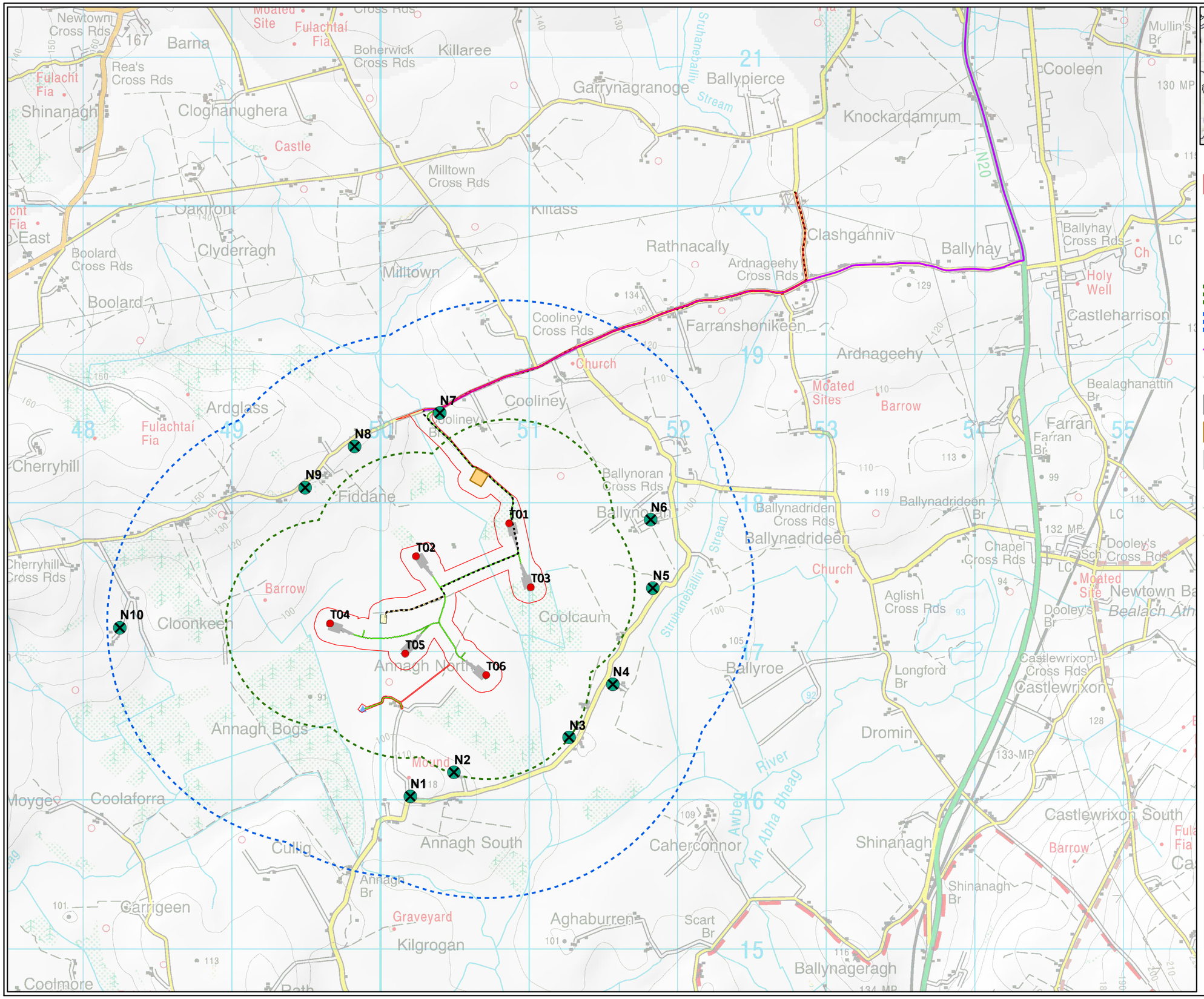
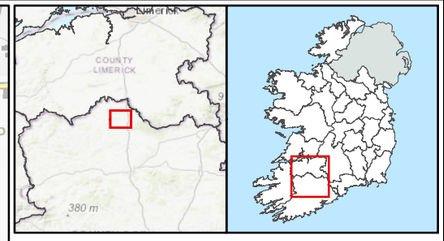


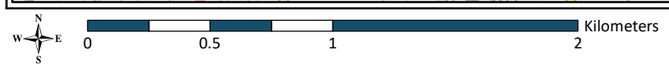


Legend

- Site Boundary
- Noise Monitoring Locations
- Turbine Layout
- Met Mast
- Turbine Layout 700m Buffer
- Turbine Layout 1.5km Buffer
- Turbine Delivery Route
- Underground Cable Route
- Substation
- Construction Compound
- Turbine Hardstanding Area

Roads

- New
- Upgrade



TITLE: Noise Monitoring Location Details			
PROJECT: Annagh Wind Farm, Co. Cork			
FIGURE NO:	7.2		
CLIENT:	EMPower		
SCALE:	1:25000	**REVISION:**	0
DATE:	12/10/2021	**PAGE SIZE:**	A3

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8. BIODIVERSITY

8.1 Existing Environment

The proposed wind farm site is located north of Churchtown, Co Cork at Annagh, in a poorly drained level depression within the upper Awbeg River catchment west of the Ballyhoura Mountains. The proposed grid connection is also within the Awbeg catchment, which lies within the Munster Blackwater Catchment. The watercourses flowing through and adjacent to the proposed site drain to the Awbeg, which is located to the south of the proposed site and in turn drains to the (Munster) Blackwater south of Castletownroche.

The Annagh study area is underlain by calcareous bedrock composed of limestone & calcareous shale, while river alluvium and clayey drift with limestones are the predominant soils and subsoils. Siliceous subsoils (clayey shales and sandstone till) are present in fringing areas. The wind farm site is largely covered in broadleaved forestry plantation, with wet grassland and improved agricultural grassland also present. Land use practices throughout the study area are divided between improved agricultural pasture, broadleaved commercial afforestation and extensively grazed wet grassland. The site also consists of hedgerow, treeline, drainage ditches and outlying conifer plantations, marsh, dry meadows, grassy verges, reed and large sedge swamps, buildings and artificial surfaces.

Invasive species recorded in proximity to the study area include cherry laurel planted along the L1322 road/field boundaries. Sycamore is present at the proposed site entrance. Montbretia is present on the banks of the Oakfront river near the site entrance. This area is outside the proposed development footprint. The non-native species Wilson's honeysuckle *Lonicera nitida* is also present at the proposed site entrance. Cherry laurel, snowberry *Symphoricarpos albus* and sycamore were identified along the proposed grid route. A total of nine invasive species were recorded across eleven locations along the turbine delivery route but not located within the footprint of the required works.

8.1.1 Designated Sites

There are two Special Areas of Conservation within the potential Zone of Influence of the proposed Annagh Wind Farm Study Area. One of these is also within the potential Zone of Influence of the Grid Connection Route due to a hydrological linkage. There are five Special Area of Conservation within the potential Zone of Influence of the Turbine Delivery Route.

There are two Special Protection Areas within the potential Zone of Influence of the proposed wind farm. There is one Special Protected Area within the potential Zone of Influence of the Turbine Delivery Route.

An Appropriate Assessment Screening Report and Natura Impact Statement have been completed in order to appraise the likely significant effects of the proposed development either alone or in combination with other plans or projects on European Designated Sites; these accompany this planning application.

There are no Natural Heritage Areas within the Zone of Influence of the proposed wind farm and grid route. There are seven proposed Natural Heritage Areas within the Zone of Influence of the wind farm and grid connection. A further four proposed Natural Heritage Areas and are present within the potential Zone of Influence of the Turbine Delivery Route.

Designated European sites include:

- Blackwater River (Cork/Waterford) Special Area of Conservation
- Ballyhoura Mountains Special Area of Conservation
- Lower River Shannon Special Area of Conservation
- Barrigone Special Area of Conservation
- Curraghchase Woods Special Area of Conservation
- Askeaton Fen Complex Special Area of Conservation
- Kilcolman Bog Special Protected Area
- Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle Special Protected Area
- River Shannon and River Fergus Estuaries Special Protected Area

Designated National sites include:

- Ballyhoura Mountains proposed Natural Heritage Area
- Ballinvonear Pond proposed Natural Heritage Area
- Eagle Lough proposed Natural Heritage Area
- Kilcolman Bog proposed Natural Heritage Area
- Mountrussel Wood proposed Natural Heritage Area
- Awbeg Valley (Above Doneraile) proposed Natural Heritage Area
- Ballintlea Wood proposed Natural Heritage Area
- Castleoliver wood proposed Natural Heritage Area
- Inner Shannon Estuary – South Shore proposed Natural Heritage Area
- Curraghchase Woods proposed Natural Heritage Area
- Barrigone proposed Natural Heritage Area

The proposed Wind Farm Site and Grid Connection Route do not overlap any designated sites. Hydrological connections have been identified between the Wind Farm Site and Grid Route and the Blackwater River (Cork/Waterford) Special Area of Conservation.

8.1.2 Species

Records of native Irish mammals in proximity to the wind farm site include badger, hare, pygmy, red squirrel, otter, stoat, hedgehog, woodmouse and red fox. Records of invasive mammals include American Mink, Bank Vole, Brown Rat, European Rabbit, Fallow Deer, White Toothed Shrew and Sika Deer. Mammals recorded on recorded during surveys include Badger, Vole, Otter, Red Fox, Red Squirrel, Wood Mouse and American Mink. Records of bat roosts are located in proximity to the site. Bat surveys indicated bat activity at the wind farm site. The most commonly recorded species was soprano pipistrelle, followed by Leisler's and common pipistrelle, with much lower activity levels for *Myotis* spp., natterer's bat and whiskered bat detected.

The Oakfront Stream, Ardglass Stream, hedgerows and treelines and broadleaved and conifer plantations provide connectivity to other foraging areas in the wider landscape. High activity was recorded at the wind farm site during the survey periods.

Bird species observed at the wind farm site include buzzard, little egret, kestrel, sparrowhawk, mute swan, black headed gull, hen harrier, cormorant, grey heron, common gull, lesser black backed gull, snipe, mallard, goshawk, herring gull and peregrine falcon. Hinterland surveys were carried out. The 34 target species recorded during hinterland surveys are comprised of eight red-listed, sixteen amber listed and ten are green listed species. Within these, a total of five are Annex 1 species, namely Golden Plover, Kingfisher, Little Egret, Greenland White-fronted Goose and Whooper Swan.

8.1.3 Habitats

Existing habitats at the wind farm site include a mixture of habitat types, with wooded habitats (Mixed broadleaved woodland and Immature woodland) composed of broadleaved and mixed broad-leaf/conifer plantations forming a large portion. Agricultural land comprising Improved agricultural grassland and wet grassland dominates the remainder. Hedgerows, treelines and drainage ditches line field boundaries. The wind farm site also includes a farm yard and a derelict dwelling. The habitats of the wind farm site are illustrated in Figure 8-1.

The section of the Grid Connection Route within the main wind farm site area includes immature woodland, wet grassland, Wet grassland/Improved agricultural grassland mosaic, improved agricultural grassland, mixed broadleaved woodland and Mixed broadleaved/conifer woodland. The Grid Connection Route then entered the public road from the main site entrance to the Existing Charleville 110kV Substation. The dominant habitat along this section is buildings and artificial surfaces represented by road surfaces. The roads are bounded by hedgerows, treelines and a mosaic of these habitats.

Works are also required at 18 locations along the Turbine Delivery Route to accommodate the transport of large turbine components. No flora listed on the Flora Protection Order or listed as threatened on the Irish Red list were recorded during site walkovers at the Turbine Delivery Route Nodes.

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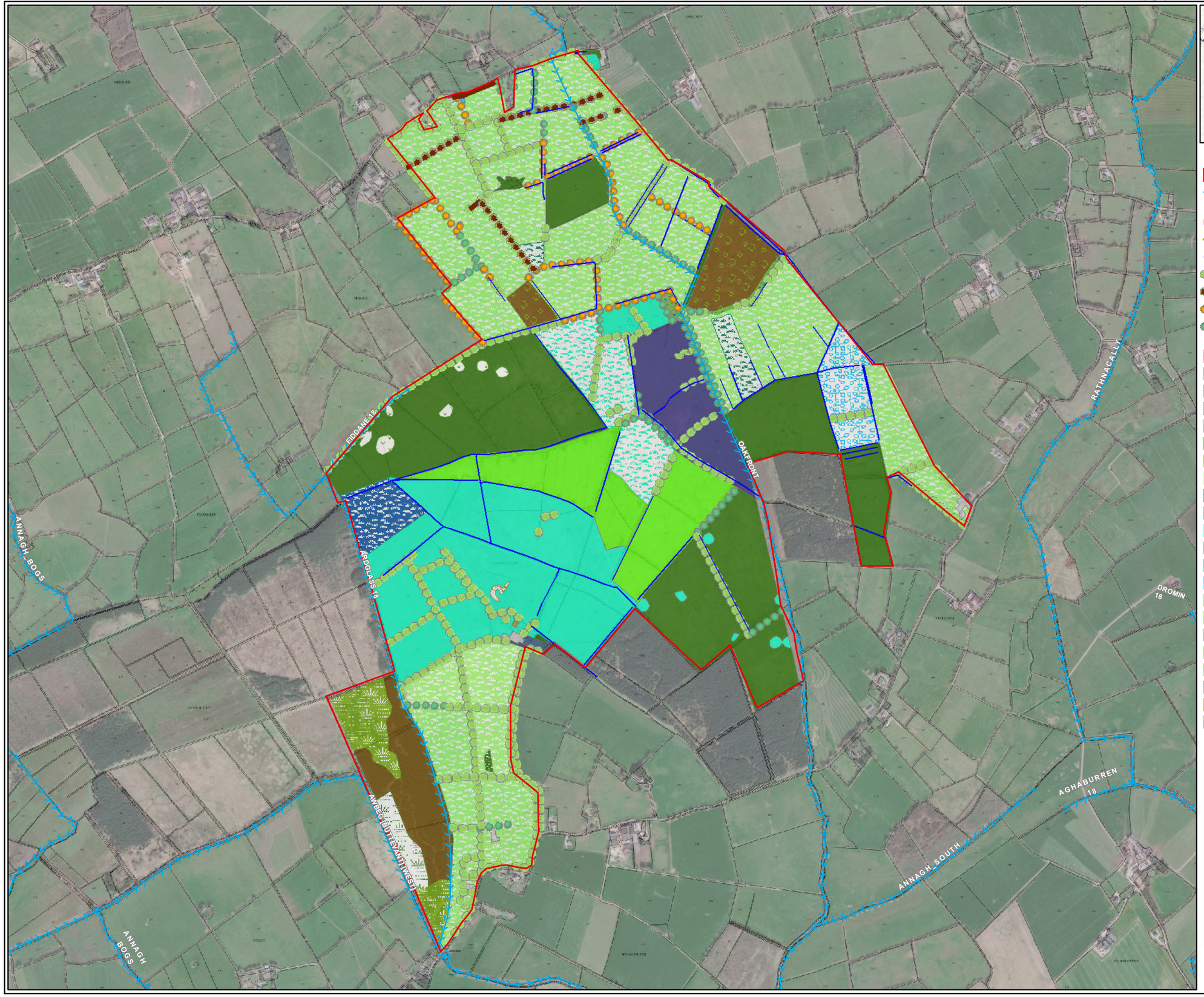

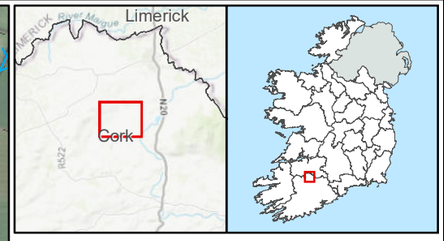

Legend

- Study Area
- Rivers

Linear Habitats

- BL2 Earth banks
- ED2 Spoil and bare ground
- FW4 Drainage ditches
- WL1 Hedgerows
- WL1/BL2 Hedgerows / Earth banks
- WL1/WL2 Hedgerows / Treelines
- WL2 Treelines

Habitat Areas

- BL1 Stone walls and other stonework
- BL3 Buildings and artificial surfaces
- ED3/WS1 Recolonising bare ground / Scrub
- ED5 Refuse and other waste
- FL8 Other artificial lakes and ponds
- FS1/WD1 Reed and large sedge swamps / (Mixed) broadleaved woodland
- FS1/WD4 Reed and large sedge swamps / Conifer plantation
- GA1 Improved agricultural grassland
- GA1 Improved agricultural grassland (Rank)
- GS4 Wet grassland
- GS4 Wet grassland [Wet Meadow]
- GS4/GA1 Wet grassland / Improved agricultural grassland
- GS4/GM1 Wet grassland / Marsh
- GS4/GM1/WD4 Wet grassland / Marsh / Conifer plantation
- GS4/GS2 Wet grassland / Dry meadows and grassy verges
- GS4/WS1 Wet grassland / Scrub
- WD1 (Mixed) broadleaved woodland
- WD1/WS1 (Mixed) broadleaved woodland / Scrub
- WD2 Mixed broadleaved/conifer woodland
- WD4 Conifer plantation
- WS1 Scrub
- WS2 Immature woodland

TITLE:	Habitats		
PROJECT:	Annagh Wind Farm		
FIGURE NO:	8.1		
CLIENT:	EMP Group		
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8.1.4 Aquatic Ecology

In terms of aquatic ecology, the Fiddane Stream is a small, historically modified tributary of the Ardglass River which runs along the north-western land ownership boundary for c.0.5km. The Ardglass River is a small, historically modified tributary of the Awbeg River, to which it joined at Annagh Bridge. The short watercourse (2.6km length) river flows in a loosely north-south direction, forming the western land ownership boundary. The lowermost c.1km of the river forms a boundary of the Blackwater River Special Area of Conservation (002170).

The Awbeg River (west branch) is the major watercourse associated with the proposed Annagh development. The Awbeg flows in a loosely north-west-south-east direction and joined the River Blackwater south of Castletownroche, c..37.5km downstream of the proposed wind farm site. Much of the river's course is located within the Blackwater River Special Area of Conservation (002170)

The Oakfront River is a small, historically straightened tributary of the Awbeg, which it joins c.1.3km south of the bridge at Coolcaum. The Oakfront drains an area north of the proposed wind farm and flows through the centre of the wind farm site in a loosely north-south direction. The lowermost 1.3km of the river forms part of the Blackwater River Special Area of Conservation (002170)

The Rathnacally Stream is a small, historically straightened tributary of the Awbeg River (east branch), which adjoins the main (western) branch of the Awbeg at Scart Bridge. The Turbine Delivery Route and Grid Connection Route cross this watercourse via a local road bridge at Rathnacally, near Ardnageehy Cross Roads.

The aquatic ecological value of the site was found to be of local importance (lower value). Sites on the Awbeg, Oakfront and Rathnacally watercourses were evaluated as being of International Importance given their location within the Blackwater River (Cork/Waterford) SAC. During fisheries surveys, four species of fish were observed in total, namely: Lamprey sp., European Eel, Brown Trout and Three-spined Stickleback. No Freshwater Pearl Mussel or suitable habitats for this species were recorded within the study area during the aquatic surveys.

No White-clawed Crayfish were detected within the study area using traditional methods; however, eDNA sampling indicated the presence of this species at cryptically low densities in both branches of the Awbeg river. No aquatic flora communities with to the Annex I habitat '*Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation*' (3260) (i.e. 'floating river vegetation') were present at any of the sites. No invasive aquatic species were recorded during aquatic surveys.

8.2 Potential Impacts

8.2.1 Construction Phase

There are no designated European sites within the proposed main wind farm site and grid connection, therefore no direct impacts are predicted during construction for these elements of the project. The Turbine Delivery Route is immediately adjacent to Askeaton Fen Complex Special Area of Conservation, Lower River Shannon Special Area of Conservation, River Shannon and River Fergus Estuaries Special Protection Area, Barrigone Special Area of Conservation and Curraghchase Woods Special Area of Conservation along the section traversing the N69 national road. No works are required within any of these European sites.

An Appropriate Assessment Screening Report and Natura Impact Statement (NIS) have been prepared to provide the competent authority with the information necessary to complete an Appropriate Assessment for the proposed project in compliance with Article 6(3) of the Habitats Directive.

The grid connection route does not traverse any designated nature conservation site. Therefore, no direct impacts are predicted. Nodes along the Turbine Delivery Route where accommodation works are required come in proximity to a number of designated sites including the Inner Shannon Estuary – South Shore proposed Natural Heritage Area, the Lower River Shannon Special Area of Conservation (002165) and the River Shannon and River Fergus Estuaries Special Protected Area (004077). All works associated with the Turbine Delivery Route are located within the road corridor.

The potential for likely significant effects to aquatic conservation interests for the Blackwater River (Cork/Waterford) cSAC (002170) arising from dust and emissions to water (sediment/hydrocarbons) at construction stage could not be ruled out.

The potential for likely significant effects to Kilcolman Bog SPA (004095) via disturbance of SCI bird species due to construction works could not be ruled out, due to the presence of Whooper Swan within 1km of the site.

The potential for likely significant effects to aquatic conservation interests for the Lower River Shannon SAC (002165) arising from emissions to water (sediment) and disturbance to otter at afforestation stage could not be ruled out.

The potential for likely significant effects to aquatic conservation interests for the River Shannon and River Fergus Estuaries SPA (004077) arising from emissions to water (sediment) and disturbance to bird species at afforestation stage could not be ruled out.

The aforementioned effects could not be ruled out on the basis of available scientific information, project details provided by the client, and best scientific knowledge, and as such it is submitted that an appropriate assessment is required with regard to the sites identified above.

The NIS has assessed the potential effects on the integrity of the Blackwater River (Cork/Waterford) cSAC, Lower River Shannon SAC, and River Shannon and River Fergus Estuaries SPA in light of these sites' conservation objectives and mitigation measures have been developed to prevent such potential effects occurring.

The NIS has also assessed the potential effects on the integrity of the Kilcolman Bog SPA and Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA in light of these sites' conservation objectives and found no potential for adverse effects.

In the light of the conclusions of the assessment which it shall conduct on the implications for Blackwater River (Cork/Waterford) Special Area of Conservation, Lower River Shannon Special Area of Conservation, River Shannon and River Fergus Estuaries Special Protected Area, Kilcolman Bog Special Protected Area and Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle Special Protected Area the competent authority is enabled to ascertain that the proposed project will not adversely affect the integrity of any of these European sites.

Direct and indirect effects on these proposed Natural Heritage Areas are not predicted due to the proposed works being small scale and predominantly within the road; any habitat damage/dust deposition will be localised and temporary, lands will be reinstated, and lack of physical connectivity to nationally designated sites.

The grid cable installation methodology of horizontal directional drilling at the Rathnacally Stream crossing point means no significant effects on the aquatic environment will occur. Taking this into account, in addition the instream distance of 20 km between the Awbeg Valley (Above Doneraile) proposed Natural Heritage Area (000075) and the Grid Connection Route crossing point, no effects are predicted to arise from grid cable installation for this proposed Natural Heritage Area in this regard.

Additional works at 'Nodes' along the Turbine Delivery Route will be comprised of the trimming of vegetation, placement of load bearing surfaces (aggregate). Lowering of walls/fences and removal of street furniture (and associated reinstatement). Invasive species were identified along the Turbine Delivery Route and as such, invasive species management measures are proposed to restrict their spread.

8.2.2 Habitats and Flora

The construction phase will result in a degree of habitat damage and loss. The habitat loss will be the total area covered by the access tracks (new sections and upgrading of existing tracks), plus the footprint associated with each of the 6 proposed turbines (foundations, hard standings, and associated felling buffers) and all other wind farm infrastructure.

The most abundant habitat type within the study area is Improved agricultural grassland which on its own accounts for 35.1% (105.5 Hectares) of the study area. This is followed by (Mixed) broadleaved woodland which accounts on its own for 20.8% (62.36 Hectares) of the study area. Wet grassland is the third most abundant habitat within the study area, accounting for 16.4 % (49.22 Hectares) of the total.

Indirect impacts on habitats and flora include the spread of invasive species which could be distributed during construction works. During the site walkovers one invasive species was observed at the main wind farm site, namely Cherry laurel Prunus laurocerasus which is present at intervals in the hedgerow where the site entrance meets the L1322 local road. Sycamore is present within the wind farm study area in hedgerow/tree-line remnants but was not observed within proposed infrastructure footprint or wind farm site. Construction works within the main wind farm site, Grid Connection Route and Turbine Delivery Route could affect the existing environment by facilitating the spread of these species. It is considered that prior to mitigation a Long-term Moderate Reversible Impact could arise.

Deposition of dust could affect adjacent terrestrial habitats by inhibiting plant growth and contributing to the sediment load in watercourses. The proposed wind farm site is a major construction site, which will result in soiling effects potentially occurring up to 100m from the source, with PM10 (particulate matter) deposition and vegetation effects occurring up to 25m. A Short-term Moderate Reversible Impact in terms of vegetation effects is predicted. The deposition of dust in watercourses contributing to siltation of the hydrological network is identified as a *Short-term Not Significant Reversible Impact.*

The significance of the effect of the increase in surface water runoff on receiving waters is Not Significant because estimated increases in the peak runoff is low compared to the flows of receiving waters. As surface water flows will be maintained, any alterations in surface water flows will be temporary and are predicted to result in Temporary Imperceptible effects on terrestrial habitats.

The dewatering of excavations for turbine base construction could result in the drying out of surrounding habitats. As dewatering is a temporary measure, Temporary Slight-Moderate effects are predicted.

8.2.3 Mammals (excluding Bats)

Potential direct impacts during the construction of new tracks, turbine hardstanding areas, substation in addition to felling buffers will lead to a permanent loss of c. 18.44 Ha or 6.1 % of habitats within the study area. In parallel, the felling and maintenance of buffer zones surrounding turbines located in plantation woodlands will result in habitat alteration (from plantation woodland to scrub and grassland type habitats). The majority of wooded habitats within the study area will be retained, and similar habitats are present in the general area. Similarly, the loss of open habitats will be minimal and similar habitats are present in the surrounding landscape.

As such, the relatively small-scale loss of habitat at the wind farm site will not result in a significant negative impact on the distribution of local protected mammal fauna including Pygmy Shrew, Irish Hare, Irish Stoat, and Hedgehog.

Any unmitigated impacts to these species will be a Short-term Imperceptible Reversible Impact.

No impact is envisaged as a result of habitat loss along the Turbine Delivery Route or grid connection route as the habitats are highly modified/disturbed and due to the limited footprint of works.

Indirect impacts during the construction phase of the development may result in temporary disturbance to fauna, however as this will be temporary in duration, and given the habitats present in the wider environment, affected mammals will be able to move to other locations in the wider area until the disturbance has ceased. There is the potential for disturbance to Badger setts within and in close proximity to construction works. As such, the potential exists for a Short-term Significant Reversible Impact to Badger prior to mitigation.

Prior to mitigation, there is potential for indirect impacts to Otter through the transport of pollutants and/or contaminants which could negatively affect the aquatic animals such as Salmonids on which Otter depend. These impacts could occur as the result of felling and/or construction activities. As such, any impacts on Otter prior to mitigation are predicted to be Short-term Significant and Reversible.

The main wind farm site is comprised predominantly of pasture and wooded habitats. Watercourses are limited to small streams which have both open and enclosed sections. The hedgerows/tree-lines and plantation woodland edges bounding pasture provide connectivity to the wider landscape. The commuting and foraging habitats over most of the study area are of high suitability for bats. Foraging or commuting bats may suffer disturbance impacts during the construction phase of the development through increased noise and lighting on the site.

However, mitigation measures including restrictions on night-time working and use of appropriate lighting will minimise or avoid these impacts. As no roosts were recorded within the site the impact to bats during the construction phase will be a Medium-term Slight to Moderate Impact and will require mitigation measures.

8.2.4 Bird Species

The effects of infrastructure such as wind farms on birds are highly variable and depend on a wide range of factors including the specification of the development, the topography of the surrounding land, the habitat affected, and the numbers and species of birds present. The principal concerns in terms of adverse effects on birds are (1) disturbance displacement, (2) collision, (3) habitat loss/change and (4) barriers to movement.

Regarding impacts on bird species, it is considered that the main potential source of impacts on avian fauna is the construction of the wind farm, particularly the construction of turbines and the associated road network.

The potential likely significant impact of wind turbines on birds may be considered as:

- Possible loss or deterioration of habitats; and
- Disturbance or displacement of birds.

the construction of the proposed grid connection will progress in a sequential manner along the grid connection route and therefore, the works in any one location will be of a temporary duration, any fugitive noise will be highly localised, temporary and are not expected to be of sufficient magnitude to create any disturbance or displacement impacts outside of areas contiguous or adjacent to the corridor.

Habitat Loss or Alteration

The construction of the wind farm tracks, turbine foundations and hard standings, substation compound and temporary site compound will result in some habitat damage and loss. Permanent felling of broadleaved and mixed broadleaved/conifer forestry will also be required around the turbines and along the new access roads. The habitat loss will be the total area covered by the roads plus the footprint of each of the 6 proposed turbines. Felling will be required at all 6 turbines. Habitat that will be lost will be dominated by broadleaved and broadleaved/conifer plantations, followed by Improved agricultural grassland and Wet grassland.

During additional works along several areas of the Turbine Delivery Route there will be trimming of hedgerows and tree-lines which will result in a temporary loss of foliage within these habitats. Tree felling and lowering of hedgerows will cause longer term effects and greater alteration of habitats.

It is not expected that the wind farm development will cause a reduction in the baseline population of passerines as the area of nesting/foraging habitat lost will be Imperceptible to Slight. It is considered that the proposed impact of habitat loss will be a Permanent Imperceptible to Not Significant Impact which is Reversible. However, the trimming of vegetation along with the removal of scrub or felling of trees during the nesting season for birds could result in a Localised Temporary Significant Reversible Impact to nesting birds.

Disturbance or Displacement

Indirect effects on bird species may occur during the construction phase. Disturbance and/or habitat loss will likely be Short-term Slight to non-significant impact, and temporary imperceptible to the majority of species identified at the wind farm site. However there is potential for short-term moderate to significant impact on woodcock, snipe, peregrine falcon, kestrel and kingfisher species during the construction phase.

8.2.5 Aquatic Ecology

The principle impacts from the proposed development on the aquatic environment are expected to occur during the construction phase. Primarily, these risks relate to water pollution and or contamination via siltation (suspended solids), hydrocarbons, concrete etc. The Construction Environmental Management Plan (CEMP), which details the construction methodology, has been developed to minimise the requirement for in-stream works and to reduce the risk of potential contamination and water pollution.

Tree felling

Localised tree felling will be required in the vicinity of turbines T1, T2, T3, T4, and T6 hardstand areas, the substation (and associated access track) and along the access tracks to T1, T4 and T6. It is estimated that c.12.6 hectares of existing broadleaf forestry will be felled to facilitate development of the proposed wind farm infrastructure (e.g., turbine hardstands, substation compound, associated access tracks and bat felling buffers). There are potential source-receptor pathways from felling areas to both the Ardglass River and Oakfront River.

In light of the location of these felling areas in relation to surface water features (i.e. drainage ditches) and watercourses, there is potential for felling to contribute to an increase in site run-off. This may lead to the release of suspended solids, contaminants and or nutrients which impact water quality within the Ardglass River which is c.120m from T4 via a drainage channel, and the Oakfront River situated c.160m from T3 via a drainage channel. The introduction of suspended solids, contaminants and or nutrients to waterways may induce increased mortality of aquatic invertebrates & fish eggs, increase eutrophication and impact downstream fish, otter, kingfisher, invertebrates and spread invasive species along watercourses.

The overall felling area proposed is small (c.12.6 hectares) when compared to commercial conifer clear-felling operations taking place within the catchment nearby (primarily the Ballyhoura Mountains). In relation to this tree felling operation, the potential for impacts associated with nutrient run-off or leaching is relatively low as nutrient leaching would be less severe in a lowland setting with broadleaf-dominated forestry where little or no fertilisation has occurred than, for example, an upland conifer plantation which was heavily fertilised. The potential impact as a result of tree felling and felling related activities on downstream aquatic habitats and species are likely moderate negative, and short-term and in the local context, with downstream aquatic qualifying interests of the Blackwater River Special Area of Conservation (002170) likely significant negative, short-term and in context of the European site.

Replant lands

Trees felled for development purposes will be replanted at another unplanted location as required by Irish Forest Service Guidelines. The proposed development will require the felling of forestry within and around the infrastructure to accommodate the construction of turbine foundations, hard stands, crane pads, access tracks, and substation compound. The overall area of tree clearing required for the proposed development will be c. 12.6 ha. A felling licence will be sought from the Forest Service prior to any tree felling and will include the provision of relevant replant lands. The impact on broadleaf renewable timber resources within the study area as a result of felling is considered long-term, slight and negative.

However, the overall effect of the proposed development on renewable timber resources at a national scale will be neutral. Replant lands have been identified at Emlagh, Co. Clare. The total area for replanting is c. 12.6 ha.

Access track Construction

Access to the proposed wind farm will be achievable via existing access points and trackways currently in agricultural use. There is c. 0.4km of existing agricultural access tracks will be upgraded and utilised during the construction phase, with c. 4.5 km of new internal access tracks, plus c. 0.1 km of turning heads necessary to facilitate site access and construction activities. New access tracks and upgrade of existing tracks may involve tree felling and hedge trimming to allow upgrading of existing roadside ditches to allow necessary road/track widening.

These activities have the potential to convey suspended solids and contaminants (e.g. nutrients, hydrocarbons) to receiving watercourses, and have the potential to contribute to the increase in surface water run-off and cause more localised water quality impacts through sediment and or nutrient-laden run-off, including from tree felling areas associated with new tracks. Works leading to erosion of the river banks/bed could result in the release of suspended solids. This may impact sensitive aquatic ecological receptors in receiving watercourses through mobilisation of sediment and or contaminants, as well as additional erosion, resulting in impacts to both water quality and aquatic habitat. Access track construction will also require localised tree felling, primarily in the vicinity of turbines T1, T5 and T6.

Potential impact significance on all downstream aquatic habitats & species associated with access track construction is considered likely moderate negative, short-term and in the local context, with all downstream aquatic qualifying interests of Blackwater River SAC (002170) likely significant negative, short-term and in context of the European site.

Once the Annagh Wind Farm is operational, the potential for negative effects on material assets is minimal. Maintenance of access tracks and infrastructure may require small amounts of imported fill, however, the impact of this is likely to be slight/imperceptible. Decommissioning works will include removal of above ground structures including the turbines and met masts, with turbine foundations and access tracks to be left in situ.

To further mitigate the effects of access and track construction, existing agricultural tracks have been incorporated into the design in order to minimise the construction of new tracks and minimise the removal of agricultural and forested areas. Where new access tracks are required, these have been sensitively designed in order to minimise impact on agriculture and forestry so far as possible. Electricity cables will be installed underground in or alongside access tracks to avoid negative effects on agricultural and forestry practices.

To mitigate against impacts on aquatic ecology due to track construction and widening, it is proposed to upgrade c. 0.4km of existing agricultural roads. All track widening will be undertaken using clean uncrushable stone with a minimum of fines. Road drainage will be over the edge, where the surface runoff will be collected in swales. Swales will be connected to settlement ponds at the end of the swale. Settlement ponds will discharge treated water overland via a diffuse outfall which will minimise any risk of soil erosion and allow further filtration of any remaining sediment particles.

This treated water will ultimately percolate to ground or travel overground and be assimilated into the existing drainage network within the boundary of the proposed development at appropriate greenfield run-off rates. There will be no direct discharges from the wind farm to any existing natural watercourse. The settlement ponds will be designed to provide sufficient retention time and a low velocity environment to allow suspended solids of a very small particle size to fall out of suspension prior to allowing the water to outfall to the receiving environment.

Turbine base and met mast construction

The construction of 6 no. wind turbines (with a transformer at each turbine and associated hardstand areas) and 1 no. met mast will include construction activity, large-scale earthworks, drainage and pouring of concrete. The 6 no. turbines have been positioned at a minimum distance of c.120m (measured along flow paths) from the riverine watercourses draining the site (i.e. Ardglass River and Oakfront River). The proposed met mast is located >80m from the nearest potential hydrological pathway (i.e. drainage channel with indirect connectivity to the Ardglass River).

The greatest threat to aquatic ecology from turbine base construction (based on site topography and the layout of surface water features) is impacts to water quality identified at turbines T3 and T4 which are located c. 130m and 170m from the Ardglass River and Oakfront River. Although the aquatic ecological evaluation of the heavily-modified Ardglass River was considered of local importance (lower value) only, the Oakfront River supported brown trout, European eel, *Lampetra* sp. (Blackwater River Special Area of Conservation qualifying interest), three-spined stickleback, kingfisher and otter (Blackwater River Special Area of Conservation qualifying interest). Both the Ardglass and Oakfront Rivers share downstream hydrological connectivity with the Awbeg River and Blackwater River Special Area of Conservation (002170), with the shortest hydrological distances from proposed infrastructure to the European site being 0.7km and 1.4km, respectively (via surface water drains and the rivers). The Awbeg is known to support a range of aquatic qualifying interest species and habitats, including otter, Atlantic salmon, lamprey species and white-clawed crayfish.

The earthworks required to facilitate turbine base construction may liberate nutrients and increase the sediment load of surface water run-off, potentially impacting water quality and aquatic sensitivities (e.g. fish, macro-invertebrates, otter, white-clawed crayfish) in adjacent and downstream watercourses the Oakfront River, Ardglass River, Awbeg River and Blackwater River Special Area of Conservation (002170). Thus, given the proximity and hydrological connectivity of turbines T3 and T4 to these receiving watercourses, there exists a risk of water quality impacts to aquatic receptors via siltation, nutrient run-off and pollution associated with turbine base construction. Further contamination issues may arise during construction as wet concrete is poured for turbine bases and met mast construction or where rinsing of truck chutes on-site could lead to contamination of receiving waters via surface water run-off.

Heavy machinery required for turbine base and met mast construction may also lead to pollution of nearby receiving watercourses due to accidental spillage of fuels and hydrocarbons, with haul tracks crossing the Oakfront River or passing close to the sites drainage channel network could allow the migration of silt-laden run-off into adjacent watercourses. There is also a risk that machinery required for construction could act as a vector for introducing or dispersing non-native invasive species, which may spread along nearby watercourses.

During site surveys, no invasive species were identified in the vicinity of the proposed turbines or site access tracks and the geographical separation of same from adjacent watercourses reduces this risk considerably. Furthermore, there is little direct connectivity between the turbine locations or met mast site and the receiving watercourses draining the site. However, given the close proximity of turbines T3 and T4 to the receiving riverine watercourses and the proximity of the proposed met mast from surface water drains, potential impacts to aquatic ecology resulting from turbine and met mast construction do exist, but are considered moderate negative, short-term and in the local context, in the absence of mitigation. At its shortest distance, the Blackwater River Special Area of Conservation (002170) is located c.0.7km and 1.4km downstream of wind farm site infrastructure respectively (via surface water drains and the Ardglass and Oakfront Rivers). Potential impacts to local populations of qualifying interest Atlantic salmon, lamprey species, white-clawed crayfish and otter and Annex I habitats are considered significant negative, short-term and in context of the European site, in the absence of mitigation.

Site drainage

The construction phase may result in significant changes or alterations to the existing drainage network within the wind farm boundary, which may increase sediment and nutrient loads to receiving watercourses within, adjoining or draining the site. No alterations to existing drainage are proposed or expected outside of the wind farm boundary (e.g. along the Turbine Delivery Route or grid connection route).

Within the boundary of the proposed wind farm, there are several watercourse (drains) crossings to be installed for the wind farm access tracks, with track widening involving slight relocation of existing roadside drains. For small crossings over the field and forestry drains, pre-cast box culverts are proposed. Manmade agricultural and forest drains will be crossed using 450mm diameter pipes. Where cross drains are to be provided to convey the drainage across the track, the minimum sizes of these cross drains are 300 mm diameter pipes. Culverting may increase surface water run-off (flow) to the receiving Ardglass River and Oakfront River, mobilising and increasing siltation rates and exacerbating the risk of other water quality impacts (e.g., eutrophication). Site drainage, including silt traps and stilling ponds, will be put in place in parallel with construction, such that excavation for new infrastructure will have functional drainage system in place.

Inappropriate management of the carrying out of these modifications could result in blockages of existing roadside drainage and drainage swales, which may both increase the risk of water contamination to adjacent watercourses via siltation, fuel spillages etc., as well as cause alterations in the existing hydrology of the wider site. Inappropriate management of the excavated material associated with construction (e.g. inadequate silt fences on drainage channels or ponds alongside access/haul tracks) could also lead to loss of suspended solids to surface waters.

Given the likely small-scale of site drainage-related events due to geographic separation and limited surface water pathways to receiving watercourses, potential impacts to aquatic ecology resulting from alterations to/inadequate site drainage management are considered moderate negative, short-term and in the local context, in the absence of mitigation. Potential impacts to Blackwater River Special Area of Conservation (002170) qualifying interest species and habitats are considered significant negative, short-term and in context of the European site, in the absence of mitigation.

Grid connection route

The proposed underground grid connection cable route, which is c. 6km in length, follows to be constructed access tracks and local public roads to connect to the existing Charleville 110Kv substation in the townland of Rathnacally, 2.8km north-east of the wind farm site entrance. The cable ducts will be placed in the verge or carriageway of the public road network, whilst along internal site tracks, the cable ducts will be installed above proposed pre-cast concrete box culverts. The proposed grid connection trench will be up to 930mm wide and up to 1200mm deep. Where the proposed grid connection cable route encounters minor culverts, the ducts will be installed above or below the culvert depending on its depth in accordance with construction methodologies outlined in the CEMP.

Excavation of the Grid Connection Route trenching presents a potential risk to water quality from silt and hydrocarbons during construction. There is a potential impact, in the absence of mitigation measures, of sediment-laden run-off in surface water from the ground surface surrounding the cable trench. Wheel rutting from machinery could allow the migration of silt-laden run-off into adjacent watercourses via surface water pathways. Along the on-site access tracks, concrete (lean-mix) will be used as backfill around the ducting with excavated material used on top. Concrete has a high pH and presents a potential significant risk to the aquatic environment. Underground cabling can potentially provide a preferential flow path for surface water.

In addition to the crossing on 6 no. drainage channels, there will be a requirement for 2 no. riverine watercourse crossings along the Grid Connection Route in total. These are on the Rathnacally Stream (report reference: GCR-WCC1) and Oakfront River (report reference WF-HF5). The crossing of the Rathnacally Stream on the L1322 will be via horizontal directional drilling, located c. 1.5km upstream of the Blackwater River Special Area of Conservation (002170). There is a risk of surface water quality impacts on the Oakfront River and the downstream Awbeg River and Blackwater River Special Area of Conservation (002170) during horizontal directional drilling and groundworks associated with potential directional drilling.

Watercourses crossed by directional drilling are at risk of suspended solid releases, hydrocarbon pollution and escapement of drilling lubricants (e.g. bentonite).

The release of suspended solids, would negatively affect fish populations, invertebrates and other water-dependant species, such as otter and kingfisher. Suspended solids can damage fish spawning substrata through the blocking of interstitial spaces, preventing oxygen diffusion and effecting egg/larval development, or directly smothering attaching and burrowing invertebrates, causing mortalities and changes to fish and invertebrate community composition at the local scale.

To avoid instream works, the Oakfront River will be crossed by a single span, pre-cast concrete bridge (cable ducts to be incorporated into proposed pre-cast concrete structure), located c.1.6km upstream of the Blackwater River Special Area of Conservation (002170). However, there remains potential for the release of silt or contaminants (e.g. hydrocarbons) to the Oakfront River and downstream-connecting Blackwater River SAC (002170) due to vegetation/bank clearance/excavation works and construction/plant activity. As above, it should be noted that the Oakfront River and downstream-connecting Awbeg River, already suffer from significant siltation and water quality pressures.

Potential impacts to aquatic ecology of the receiving riverine watercourses, in the absence of mitigation, are assessed as being moderate negative, short-term and at the local scale. With regards the downstream-connecting Blackwater River Special Area of Conservation (002170), potential impacts to aquatic qualifying interests are considered as significant negative, short-term and at the scale of the European site.

Turbine Delivery Route

The delivery of turbines and associated materials has the potential to impact water quality of watercourses crossed during transport. The turbine delivery route will follow the existing road network and will run for 80km from the port of Foynes, Co. Limerick via the N69, M20, N20 and L1322 to the north-eastern extent of the site, near Cooliney Bridge. Modifications along the Turbine Delivery Route will involve the temporary removal of street furniture and removal of some vegetation in addition to the temporary local widening at bends using hardcore material.

Within the vicinity of the wind farm site, the Turbine Delivery Route will cross a single watercourse, namely the Rathnacally Stream at a local road crossing on the L1322 (Report reference: GCR-WCC1). This crossing is located c.1.5km upstream (by water) of the Blackwater River Special Area of Conservation (002170). Although no instream works are proposed to this existing watercourse crossing, hedgerow trimming and wall lowering will be required to facilitate over-sail.

Given the close proximity of works to the watercourse, there is a low but potential risk of water quality impacts from sediment-laden run-off and or nutrient escapement resulting from vegetation removal. There is also a low risk of water quality impacts resulting from fuel spillage (hydrocarbons) from associated plant machinery in vicinity of the road crossing.

Potential impacts to aquatic ecology resulting from turbine delivery are considered moderate negative, short-term and in the local context, in the absence of mitigation. Impacts to the downstream-connecting Blackwater River Special Area of Conservation (002170) are considered as not significant, short-term and at the scale of the European site.

8.3 Operational Phase

The operational phase will have lower potential for impacts on the local ecology than the construction phase. The main potential operational impacts of the project will arise from the rotation of the blades of the wind turbines and, to a lesser extent, from vehicular movement in relation to wind turbine maintenance along access roads. The rotation of the blades may result in displacement of local wildlife due to the avoidance by birds of the area around the turbines. In addition, the rotating blades present a potential collision hazard to local bird and bat species. The rotation of the blades of the turbines may also result in increased noise levels which may also cause disturbance to local wildlife. There is also potential for landscaping maintenance to cause disturbance to wildlife.

The level of human activity associated with the maintenance of the operational windfarm will be infrequent and minimal given that it will be monitored remotely. The proposed wind farm is also located within an agricultural area, so there is already disturbance caused by human and machinery activity associated with agricultural management. As a result, any negative impact to terrestrial fauna as a general group during the operational phase of the wind farm is deemed to be a Long-term Imperceptible Reversible Impact.

Potential impacts on bats prior to mitigation (particularly felling buffers) are predicted to be *Long-term Significant Impacts on a Local Level* and *Reversible*. Potential direct impacts include collision with turbine blades. Indirect impacts are unlikely as due to the distances between the proposed infrastructure and identified roosts.

The primary cause of direct impact on birds during the operational phase of a development is Collision Risk. Potential collision risks on species observed at the site is considered long-term imperceptible.

The habitats within turbine felling buffers will be maintained as treeless during the lifespan of the wind farm. This will have the effect of halting succession to scrub and woodland, producing bare/disturbed ground and grassland, rougher grassland, and low scrubby vegetation with sapling trees and bramble thickets in an ongoing cycle. This will result in a neutral effect for each habitat type.

Operational wind farms are not normally considered to have the potential to significantly impact on the aquatic environment. The main risk to watercourses is via water quality impacts when oils and lubricants are used on the site (e.g. infrastructure maintenance). If such substances leaked from the turbines or maintenance areas or were disposed of inappropriately, there is a risk of water contamination and subsequent impacts to aquatic ecology. However, the likelihood of this occurring is very low, and the potential significance of this impact can be mitigated through effective mitigation and appropriate management.

Increases in the surface water run-off volume as a result of less-permeable surfaces of the wind farm (e.g. hardstands, access tracks etc.) are predicted to be less than 1% of the average daily/monthly volume in comparison to the baseline pre-development conditions. Thus, no significant operational phase impacts are predicted as a result of increases in surface water run-off. Potential operational phase impacts on aquatic ecology are considered likely slight negative, short-term and in the local context, in the absence of mitigation. Given the downstream-connectivity from the wind farm site and associated infrastructure (Grid Connection Route, sub-stations, access tracks etc.), potential impacts to aquatic qualifying interest species and habitats of the Blackwater River Special Area of Conservation (002170) are considered likely not significant negative, short-term and in context of the European site, in the absence of mitigation.

8.4 Decommissioning Phase

Decommissioning activities of the Annagh Wind Farm Project will take place in a similar fashion to the construction phase. Potential impacts will be similar to the construction phase but on a reduced scale.

A Natura Impact Statement has been prepared for the proposed development. The Natura Impact Statement addresses potential impacts on European sites resulting from the proposed project. The Natura Impact statement concluded that, in the light of the conclusions of the assessment which it shall conduct on the implications for the European sites concerned, the competent authority is enabled to ascertain that the proposed project will not adversely affect the integrity of any of the European sites concerned. Similarly, no direct or indirect effects on Natural Heritage Areas or proposed Natural Heritage Areas within 15 km of the wind farm or within the Grid Connection Route or Turbine Delivery Route zone of influence are anticipated at decommissioning stage.

The decommissioning of the wind farm may result in some temporary loss of habitat, primarily to hedgerows at access points which may require partial removal to facilitate the removal of turbine parts. The impact of this vegetation clearance would result in a *Short-term Not Significant Reversible Impact*.

In relation to mammals, vehicular traffic during decommissioning along access roads may result in fatalities; however, this is not expected to be significant due to the mainly daytime requirement for access and speed restrictions which will be in place. It is considered unlikely that direct impacts on Badger during the decommissioning process will be significant; as setts are unlikely to have become established in locations to be affected. Otters may be indirectly impacted through decommissioning works which disturb occupied breeding or resting sites which could become established during the operational phase. This is considered unlikely due to roads and stream/river crossings already being in place.

The possible direct effects on bats during the decommissioning phase of the wind farm are greatly reduced compared with the construction phase of the project; works will be limited to turbine removal, resulting in potential disturbance only. Indirect effects through limited hedgerow removal for access could occur, however and any sections removed will be short and will not sever foraging or commuting routes.

In relation to bird species, decommissioning during the breeding or wintering season may result in some disturbance to bird species due to increased human activity and noise. There will be no further habitat loss during the decommissioning phase and the resultant impact to passerine species is a *Temporary Imperceptible Reversible Impact.*

During the decommissioning phase, there would be increased trafficking and an elevated risk of disturbance to underlying soils, leading to the potential for silt laden run-off entering receiving watercourses from the wheels of vehicles (i.e. wheel-rutting). Any such potential impacts would be likely to be less than during the construction stage as the drainage swales would be fully mature and would provide additional filtration of run-off. Any diesel or fuel oils stored on main wind farm site will be bunded.

For turbine hard standings and foundations it is proposed that they are left in place and covered with local topsoil and re-vegetated. Access tracks are proposed to be left in place for use in agricultural and forestry activities. Removal of this infrastructure would result in considerable disruption to the local environment in terms of an increased possibility of sedimentation. It is considered that leaving the turbine foundations hardstanding areas in-situ will cause less environmental damage than removing them. Grid connection cables will be left in the ground, therefore no potential impacts to aquatic ecology during the decommissioning stage are likely to occur.

Potential decommissioning phase impacts on aquatic ecology are considered slight negative, short-term and in the local context, in the absence of mitigation. Potential impacts to aquatic qualifying interest species and habitats of the Blackwater River Special Area of Conservation (002170) are considered not significant negative, short-term and in context of the European site, in the absence of any mitigation.

8.5 Cumulative Impacts

In terms of acting cumulatively with the proposed development, the most relevant projects are those that may be constructed at the same time as the proposed Annagh Wind Farm project and are within the same catchment, as this increases the likelihood of impacts acting cumulatively. Solar farms have no moving parts and installation of panels creates minimal disturbance to the ground. No cumulative effects are envisaged in this regard, in relation to the two consented solar farms in close proximity to the Annagh Wind Farm site. Potential cumulative impacts on aquatic ecology are considered likely slight negative, short-term and in the local context, in the absence of mitigation.

During the operational phase, based on the evidence available in addition to the facts that there is a significant distance to the majority of the existing outlying wind farms, the closer wind farms (Boolard and Rathnacally Wind Farms) are of limited scale (two turbines each) and not immediately adjacent, the lack of migration paths during survey, along with the results of hinterland surveys undertaken for the proposed development, any cumulative impacts to birds during the operational phase would be a *Long-Term Imperceptible Cumulative Impact*.

The potential cumulative effects during decommissioning are considered to be the same as those described for the construction phase of the proposed development.

8.6 Mitigation Measures

Mitigation measures are described below which will avoid, reduce and where possible, offset likely significant impacts arising in relation to ecology from the construction, operation and decommissioning of the site. These mitigation measures shall be implemented in full.

8.6.1 Construction Phase Mitigation Measures

The following measures are incorporated into the proposed wind farm design to reduce impacts on designated sites, flora and fauna through avoidance and design:

- The hard-standing area of the wind farm has been kept to the minimum necessary for the maximum turbine envelope proposed, including all site clearance works to minimise land take of habitats and flora.
- Site design and layout deliberately avoided direct impacts on designated sites.
- All cabling for the project will be placed underground; this significantly reduces collision risk to birds over the lifetime of the wind farm.
- The grid connection routes have been selected to minimise land take of potentially sensitive habitats by following the site access tracks and public roads.

- Care has been taken to ensure that sufficient buffers are in place between wind farm infrastructure and hydrological features such as rivers and streams. Buffers of 50m from natural watercourses have been maintained, excepting where crossing points occur.
- One new stream crossing shall be required within the main wind farm site. A clear-span design has been selected to avoid instream works, and to minimise disturbance of banks and associated indirect effects such as siltation.
- Directional drilling is the proposed installation method where the grid connection crosses the Rathnacally stream. As such, in-stream works will not be required and the potential for contaminant or pollutant input will be greatly reduced as a result.
- The grid cable will be incorporated in the clear span bridge where it crosses the Oakfront stream within the proposed site.
- The design of the grid connection was also carried out with cognisance to ecological features. Cables are to be placed underneath public roads where possible to avoid impact to roadside hedgerows.
- The design of Turbine Delivery Route Nodes 5 and 6 was carried out with cognisance of the adjacent Inner Shannon Estuary – South Shore proposed Natural Heritage Area. The route identified is constrained to the existing public road network and does not overlap or abut any habitats, supporting habitats or features of interest for this site.

A Project Ecologist/Ecological Clerk of Works will be employed for the duration of the construction phase to ensure that all the mitigation measures outlined in relation to the environment are implemented. The area of the proposed works will be kept to the minimum necessary, including all site clearance works, to minimise disturbance to habitats and flora. Machinery, and equipment will be stored within the site compound. Designated access points will be established within the site and all construction traffic will be restricted to these locations. Access to the site will be primarily via the existing local road L1322. HGVs shall approach the site via this road from the East. The met mast access route will be via the existing farm track from the south.

Hedgerow and treeline reinstatement will be carried out for the proposed wind farm and turbine delivery route nodes following the construction phase. All hedgerow planting is required to use plants of native provenance.

Where invasive non-native species are present, measures will be implemented to ensure spread of these species is prevented, and where feasible eradicated. T turbine delivery route Node 5, an invasive species survey will be carried out prior to accommodation works and a management plan will be adhered to.

Mammals

In relation to mammals, a preconstruction mammal survey will be undertaken to reconfirm the findings of the EIAR. Construction operations will take place predominantly during the hours of daylight to minimise disturbances to mammal species at night. Badger setts within the footprint of proposed infrastructure/felling areas will require (following evacuation if active) controlled destruction under ecological supervision. Based on baseline conditions, one sett will require controlled destruction. Construction of an artificial sett will be undertaken in consultation with NPWS. Setts in close proximity to the development will require temporary hard-blocking and exclusion for the duration of construction works to ensure that Badgers potentially occupying these setts during construction works are not injured.

No vegetation removal will occur between March-August inclusive to avoid impact on breeding birds and other mammals. Outside of the bird breeding season (March 1st to August 31st inclusive) attention will be paid to the removal of vegetation, scrub and hedgerow with regards to leverets, October to March for hibernating Hedgehog and September to October for breeding Pygmy Shrew as is appropriate. Within the breeding bird season and outside of it, attention will be paid to the removal and/or maintenance of dense grassland for breeding hare (all year), pygmy shrew (April to October) and Hedgehog (April to July).

Bats

To minimize risk to bat populations, a buffer zone is required around any treeline, hedgerow, woodland feature, into which no part of the turbine should intrude, in line with Scottish National Heritage Guidance. Felling buffers around the proposed turbines range between 86m and 92m depending on the height of the surrounding trees. These areas will be kept free of vegetation throughout the lifetime of the proposed development.

Further mitigation measures to avoid impact on bat species include the following: Treelines and mature trees within the wind farm site will be avoided and retained intact. Overall impacts on these areas will be reduced through modified design and sensitivity during construction. Any trees and treelines along approach roads and planned site access tracks will be retained unless felling is unavoidable. Trees along the Turbine Delivery Route with bat roost potential which require removal will be left in situ for 24 hours prior to disposal. This will allow any bats present to escape. Where woodland edges are affected by turbine felling buffers, bats will be directed away from tree-free buffers along an alternative commuting route. This will be achieved by planting new pollinator-friendly hedgerows. Willow and Alder will also be included in these hedgerows due to their rapid growth and tolerance of damp soils.

Existing hedgerows and semi-natural scrub or semi-natural grasslands within the study area outside of the footprint of the development will be retained and incorporated into the landscaping. Disturbed areas will be allowed to recolonise naturally.

Construction operations within the wind farm site will take place during the hours of daylight where possible to minimise disturbances to faunal species at night. Where lighting is required, directional lighting (i.e. lighting which only shines on work areas and not nearby countryside) will be used to prevent overspill.

Bird Species

The removal of vegetation and scrub as well as trimming of trees along the Turbine Delivery Route will be undertaken outside of the bird breeding season (March 1st to August 31st inclusive). This will help protect nesting birds.

Where vegetation removal is required outside this period, vegetation must be inspected for nesting birds by a suitably qualified Ecologist. In the event of birds nesting within areas required to be felled suitable mitigation will be put in place and felling will only proceed upon agreement with NPWS and receipt of a wildlife licence.

Toolbox talks will be undertaken with construction staff on disturbance to key species during construction. This will help minimise disturbance.

The translocation of wet grassland from the road and hardstanding footprint associated with T02 will offset habitat loss for breeding Meadow Pipit and Skylark.

A re-confirmatory survey (March/April) will be conducted of the proposed turbine locations, Roads and hard standings to assess any evidence of Buzzard, Kestrel, Sparrowhawk, Snipe and Woodcock activity or taking up of new territories. Should any new nests be recorded, works at these locations will be restricted to outside the breeding season (April-July) or until chicks are deemed to have fledged (following monitoring). A similar survey will be implemented for Barn Owl, focusing on the derelict farmhouse near the proposed met mast access track.

Aquatic Ecology

Construction phase mitigation for hydrology will follow that outlined in Chapter 10 and the CEMP, and the mitigation measures outlined will be adhered to in conjunction with those outlined in this section. Construction phase mitigation measures for aquatic ecology predominantly involve the preservation of water quality. These will support the protection of the Blackwater River Special Area of Conservation (002170).

Given the close proximity of felling areas to receiving watercourses and potential source-receptor pathways (i.e. drainage channels), a minimum buffer zone for felling areas of 15m will be applied. Check dams/silt fences will be required within the drainage channels adjoining the Ardglass and Oakfront Rivers (i.e. those providing hydrological connectivity from felling areas to receiving watercourses). 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. Broadleaf brash mats will be used to support vehicles on soft ground 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.

Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall. It is recommended to undertake felling in the spring period to facilitate the sowing of grass seeds post-harvest to aid sediment filtration and nutrient absorption, using native grass species. Machine operations must not take place in the 48-hour period before predicated heavy rainfall, during heavy rainfall or in the 48-hour period following heavy rainfall. Removal of branch lop-and-top and other debris (brash) from felling areas within 20m of drainage channels will reduce nutrient seepage immediately post-felling and in the proceeding years after felling has occurred.

Access Track Construction

All track widening will be undertaken using clean uncrushable stone with a minimum of fines to reduce the risk of suspended solid releases to receiving watercourses. Still traps will be placed in the new roadside swales. Proposed new tracks will be drained as via roadside swales with stilling ponds at the end of the swale. These grassed swales will serve to detain flow and reduce the velocities of surface water flows.

Surface water drains within the site boundary to be crossed by access tracks during the construction phase will be via precast box culverts. Silt Protection Controls are proposed at the location of the drain crossings.

Mitigation Measures for Site Drainage

Permanent roadside drainage will be installed as part of the construction stage. This will include the use of interceptor drains, swales, check dams and stilling ponds. These measures will buffer site run-off during periods of high rainfall by retaining the water until the storm hydrograph has receded. The proposed locations of the stilling ponds are provided in the Surface Water Management Plan.

Site drainage, including silt traps and stilling ponds, will be put in place in parallel with construction, such that excavation for new infrastructure will have functional drainage system in place. The stilling ponds will remain in place during construction phase. The stilling ponds will drain diffusely overland, over existing vegetated areas, within the site boundary. The stilling ponds will be back-filled and the swales that were connected to them will be re-connected to the outfall once construction is completed. Silt protection controls are proposed.

Mitigation Measures for Grid Connection

There are two stream crossings on the proposed Grid Connection Route. The crossing of the Rathnacally Stream on the L1322 will be via horizontal directional drilling. Mitigation measures relating to water quality preservation are outlined in detail in Chapter 10. Although no-instream works are proposed, the drilling works will only be completed during a dry period between July and September (as required by Inland Fisheries Ireland for in-stream works) to avoid the salmonid spawning season and sensitive life stage period. A pre-construction otter survey to reconfirm the findings of the EIAR will be undertaken in the vicinity of the drilling locations to ensure than no breeding or resting areas are located within 150m of the drilling locations (no holts recorded in these locations to date during otter surveys).

The crossing of the Oakfront River within the wind farm site will be via a single span, pre-cast concrete bridge. This will avoid the requirement for instream works. Nevertheless, installation will only be completed during a dry period between July and September (as required by Inland Fisheries Ireland for in-stream works) to avoid the salmonid spawning season and sensitive life stage period.

8.6.2 Mitigation During Operational Phase

Habitats and Flora

Implement mitigation measures outlined in section 8.6.3.6 and Chapter 10 - Hydrology and Water Quality of this EIAR, in addition to the NIS, to ensure that there will be no contamination of water bodies due to siltation or contaminated run-off during the operational phase.

Invasive species will continue to be treated within the project area according to the invasive species management plan for as long as they persist within the site.

Either of the following options are required to be used in maintaining the wildflower meadow: actively managed grazing, or mechanical mowing.

Light annual grazing using sheep or cattle can be used to maintain the planted wildflower meadow. In spring or summer grazing of the site will be avoided to favour early or late flowering species respectively and allow the development of nectar and seeds for ground nesting birds and mammals. Active management of grazers and regular observation of conditions onsite will be required to determine the correct stocking level at the outset. It is noted that the use of sheep carries a higher risk of overgrazing if too many are present, increasing the need for close observation in the initial stages.

Mechanical mowing can also be used, either in combination with grazing, or alone. If mowing only is used, one cut and lift per year between October – February is required. This can be split into rotational mowing where half is cut late in the year and half is cut early the following year, however all areas should only be cut once per year.

Mammals

Felling/vegetation clearance operations (maintenance of felling buffers) within 50m of badger setts are not allowed during the badger breeding season (December-June inclusive).

To prevent bat collisions, turbines will operate in a manner which restricts the rotation of the blades as far as is practicably possible below the manufacturer's specified cut-in speed, ensuring they do not rotate or 'idle' when not generating power.

Curtailment will be included to reduce impact on bats. This will increase the cut-in speed of the turbine to 1.5 m/s. Increased cut-in speeds will be implemented from commencement of operation. Cut-in speeds will be increased during the bat activity season (April-October) and/or where weather conditions are optimal for bat activity from 30 minutes prior to sunset and to 30 minutes after sunrise at turbines where surveillance shows high bat activity levels for High Risk species and/or if bat carcasses are recorded. Electronic measures on the turbine will only pause/feather the blades below a specified wind speed and above a specified temperature within specified time periods which are suited to bats.

Post-constructions surveys will be undertaken for the first three years of operation to determine if blanket curtailment restrictions can be amended in line with post-construction activity. This will continue to be monitored throughout the life of the wind farm to monitor the activity of bats on site and to adjust the curtailment where necessary. The felling zones around each turbine will be maintained throughout the operational phase. Bat fatality monitoring will also be undertaken.

Bird Species

A post-construction monitoring programme is to be implemented at the subject site in order to confirm the efficacy of the mitigation measures. Flight activity surveys will be undertaken. Fatality monitoring will be undertaken.

Aquatic Ecology

The vegetation-free buffer zones around all turbines will be managed and maintained during the operational life of the development. The primary impact to aquatic ecology resulting from the operational phase of the proposed wind farm is an increase in surface water run-off from hard-standing areas, access tracks etc. A surface water management is proposed as part of the wind farm. The maintenance of the development will incorporate effective maintenance of the drainage system, including visual inspections.

Quarterly inspections of the erosion and sediment control measures on site (i.e. drains, swales, outfalls to field drains) will be undertaken for the first year following construction and annually thereafter to ensure operational efficiency.

During the operational phase, oils will be required for cooling the transformers giving rise to the potential for oil spills within the site. To mitigate this risk, transformers will be bunded to over 110% of the volume of oil within them.

8.6.3 Mitigation During Decommissioning

The same mitigation measures for the wind farm and GCR will apply for the decommissioning phase as for the construction phase.

In relation to aquatic ecology, the same mitigation measures will apply for the decommissioning phase as for the construction phase. In the event of decommissioning of the Annagh wind farm, the access tracks may be used in the decommissioning process. Mitigation measures applied during decommissioning activities will be similar to those applied during construction but will be of reduced magnitude.

It is proposed that turbine foundations and hardstand areas should be left in place and covered with local soil/topsoil to revegetate at the decommissioning stage. It is considered that leaving the turbine foundations, access tracks and hardstand areas in-situ will cause less environmental damage than removing them. The grid connection cable, ducting and substation will be left in situ as part of the national grid, therefore no potential impacts during decommissioning stage are likely to occur.

8.6.4 Vulnerability to Major Accidents or Disasters

Should a major accident or natural disaster occur, the potential sources of pollution onsite during the construction and operational phases of the Annagh Wind Farm are limited. The primary sources with the potential to cause significant environmental pollution and associated negative impacts on human health and the environment include the bulk storage of hydrocarbons, chemicals and wastes. In the case of the proposed Annagh Wind Farm development site, the storage of chemicals of this kind are strictly limited. For biodiversity, the main possible impacts are considered to be the release of sediment and pollutants into watercourses, which could negatively impact upon aquatic habitats and species.

9. LAND, SOILS AND GEOLOGY

9.1 Existing Environment

The existing environment underlying the proposed Annagh Wind Farm consists of quaternary and bedrock geology, areas of geological heritage, areas of economic interest with respect to geological resources and potential for soil contamination.

The Quaternary Geology and subsoils present within the development site and wider study area were taken from the Geological Survey of Ireland (GSI) online mapping - Quaternary Geology of Ireland (1:50,000 scale) and comprise:

- Alluvium (A);
- Till derived from Namurian Sandstones and Shales (TNSSs);
- Bedrock outcrop or subcrop (Rck).

The majority of turbine locations and associated infrastructure are located within areas classified as Alluvium. The majority of the proposed grid connection route is underlain by Till derived from Namurian sandstones and shales. During site walkover there were no indication of the presence of peat on the development site. No evidence of peat was recorded during the intrusive ground investigation.

Following the site walkover, a review of the published checklist for peat landslide hazard and risk assessment was carried out. No peat deposits were recorded. There are no known areas of soil contamination on the proposed development site or the grid connection route. No evidence of soil contamination was noted during site walkovers. As agricultural equipment is used across much of the proposed development site it is possible that minor fuel spills and leaks have occurred locally in the past.

The majority of the proposed wind farm site and a portion of the proposed grid connection is located within the Mitchelstown Groundwater Body. The status in terms of quantity and quality is classified as 'poor'. The majority of the grid connection and northern extremity of the proposed development site is underlain by the Rathnacally Groundwater Body. This is classified as 'Good'. There are no Public Water Supplies or Public Supply Source Protection Areas within the proposed development site boundary. There are however 4 No. Source Protection Areas for public water supply schemes in the vicinity of the proposed development site ranging between 8km and 10km from the wind farm site.

The Groundwater Vulnerability within the proposed development boundary is classified as 'Low' and 'Moderate', with localised areas classified as 'High', 'Extreme' and exposed bedrock. Along the proposed grid connection route, the vulnerability classification ranges from 'Low' to 'Extreme'.

A number of active and historic rock quarries and gravel pits and recorded mineral occurrences have been identified in the area of the wind farm site. None of these occur within the wind farm site.

The proposed development and proposed infrastructure locations are located within areas of 'Low' landslide susceptibility. The lands range from 90m to 110m with slopes between 1 to 4 degrees.

9.2 Construction Phase

During construction potential impacts may include soil erosion, soil compaction and or ground water pollution. The overall magnitude of the potential direct impacts associated with the construction phase of the proposed development, prior to mitigation, is considered to be a Short Term, Negative Impact of Slight to Moderate Significance. Furthermore, due to the presence of local roads within the study area and along the proposed grid connection route there is a risk of fuel leakages and other highway related contamination in the upper soils.

The following on-site activities have been identified as the sources of potential impacts on the existing geological and hydrogeological conditions during the construction phase of the proposed development:

9.2.1 Tree Felling

Felling of approximately 12.6 ha of broadleaf forestry is required within and around the wind farm infrastructure to accommodate the construction of some turbines, hardstands, crane pads, access tracks, onsite substation, grid connection, temporary compounds and permanent met masts.

Proposed tree felling will involve the use of heavy felling machinery and exposure of underlying soils to surface water runoff, which could result in soil erosion. This also could lead to an increase in sediment and nutrient concentrations in the surface water run-off which may in turn impact groundwater in the Regionally and Locally Important Aquifers beneath the proposed development site.

The use of plant and machinery during tree felling works will require the storage and use of fuels and oils. Their storage and use present potential for spills and leaks which could contaminate underlying exposed soils and groundwater.

The significance of these potential impacts on geological receptors, prior to mitigation, is considered to be Slight.

The significance of these potential impacts on hydrogeological receptors, prior to mitigation, is considered to be Significant as underlying groundwater is identified as intersecting with the Blackwater River (Cork/Waterford) Special Area of Conservation.

9.2.2 Earthworks

The proposed development will require construction phase earthworks associated with the excavation of turbine bases, removal of overburden deposits for the construction of turbine foundations, temporary site compound, sub-station, grid connection trenches, turbine hard standings, internal access roads and permanent met mast. Temporary accommodation works will also be required along the proposed turbine delivery route such as hedge or tree cutting, relocation of powerlines/poles, lampposts, signage and local road widening.

It is proposed that all onsite materials excavated shall be retained on site and re-used where suitable as part of the construction phase to minimise the import materials requirements.

Surplus Topsoil, Alluvium and Glacial Till recovered from excavations will be used for reinstatement proposed around turbine bases and hardstands.

Direct impacts to the existing geological regime associated with the construction phase of the proposed development are:

- Soil compaction may occur due to movement of construction traffic. This will occur particularly within areas of highly compressible soft deposits which are left in-situ during the construction phase. This could lead to an increase in surface water runoff due to reduced infiltration of rainfall and subsequently to an increase in erosion of overburden deposits left in-situ.
- The use of plant and machinery during construction will require the storage and use of fuels and oils. Their storage and use present potential for spills and leaks which could contaminate underlying exposed soils.
- During construction, imported engineering fill and excavated soils will be exposed in excavations and in temporary stockpiles. These soils will be subject to erosion by wind and rain which could deposit silt in streams with an indirect impact on surface water quality.

The significance of these potential impacts, prior to mitigation, is considered to be Slight.

The Impact classification is negative, slight significance, permanent, direct and high probability.

Direct impacts to the existing hydrogeological regime associated with earthworks associated with the construction phase of the proposed development are:

- Potential for groundwater pollution from the removal of overburden deposits particularly at proposed turbine locations. The aquifer underlying the proposed wind farm site and the majority of the proposed grid connection route is classified by the GSI as ranging from 'Low' to 'Medium' groundwater vulnerability with areas of 'High' and 'Extreme' vulnerability and exposed bedrock present in these areas. It is proposed to remove the overlying topsoil, alluvium and Glacial Till deposits as outlined in the proposed design.
- The vulnerability of the aquifer to groundwater pollution particularly during construction stage will be increased as overburden is removed thus reducing the level of protection from groundwater pollution.
- Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Soil erosion as a result of exposure of soils in open excavations and temporary storage of excavated materials represents a potential impact to the underlying groundwater aquifer. Groundwater underlying the site is identified as intersecting with the Blackwater River (Cork/Waterford) SAC.
- Reduction in groundwater levels from dewatering of excavations as required during the construction stage if high groundwater is encountered. This impact is most likely during the excavation of turbine foundations. There are no groundwater supply wells recorded in the immediate vicinity of proposed turbine locations. It is considered that other excavations associated with substation, temporary compound and grid connection trenches will not extend into the underlying bedrock aquifers. It is possible however that perched groundwater may exist locally within overburden deposits or weathered bedrock. Upon completion of the construction phase, it is considered that groundwater levels will revert to the pre-construction situation when there is no longer a requirement to control groundwater levels.

The significance of these potential impacts, prior to mitigation, is considered to be Significant.

The Impact classification is negative, significant significance, permanent, direct and high probability.

9.2.3 Slope Stability

The proposed development and proposed infrastructure locations are located within areas of 'Low' susceptibility.

Direct impacts to the existing environment associated with potential slope instability and failure include:

- Slope failures have the potential to impact the existing geological conditions from the removal and deposition of landslide/slope failure material and the exposure of underlying overburden deposits and bedrock to an increase in surface water runoff and subsequent increase in erosion. Slope failure also has the potential to have an impact on the safety of construction workers and forestry workers that could be in the vicinity of a landslide/slope failure event, existing infrastructure (roads, access tracks) and nearby urban areas.
- The impact of a slope failure could potentially result in the influx of acidic and/or peat laden waters into downgradient surface water features resulting in a decrease in the receiving water's pH values. This may impact groundwater quality in the underlying Regionally and Locally Important Aquifers and in any groundwater abstractions in the vicinity of a landslide event.

The significance of these potential impacts on geological receptors, prior to mitigation, is considered to be **Slight.** The Impact classification is negative, slight significance, short term, direct and low probability.

9.2.4 Internal Access Roads and Hardstands

There will be approximately 4.98km of internal access tracks associated with the proposed wind farm development. This will be a combination of existing track upgrade and construction of new tracks; approximately 4.6km of new track construction and approximately 0.38km of existing track upgrade. Hardstand areas will be provided at each turbine location.

All access tracks will be 5m wide along straight sections and 5.6m wider at bends. The access track for the met mast located at the south of the site will be 3.5m wide. The tracks will be finished with a well graded aggregate. The drainage system will be installed adjacent to the internal access tracks. Existing drainage infrastructure will be maintained and upgraded where necessary.

It is anticipated that the stone required for the construction of the internal access roads will be sourced from quarries in the vicinity. The source quarry for the supply of imported aggregate during the construction phase of the development is located at:

- Lackanamona Quarry, Mallow, Co. Cork, 25km to the south of the site.

Access track formation will consist of a minimum 500mm hardcore on a geotextile separator. The likely construction methodology for newly constructed tracks will be as follows:

- The formation will be prepared to receive the geotextile membrane.
- Stone will be placed and compacted in layers to minimum 500mm depth.
- A drainage ditch will be formed, within the excavated width and along the sides of the track.

- Surplus excavated material will be placed along the side of sections of the tracks and dressed to blend in with surrounding landscaping and partially obscure sight of the track.

Direct impacts to the existing geological regime associated with the construction of proposed access tracks and hardstands are:

- Soil compaction may occur due to movement of construction traffic. This will occur particularly within areas of highly compressible soft deposits which are left in-situ during the construction phase. This could lead to an increase in surface water runoff due to reduced infiltration of rainfall and subsequently to an increase in erosion of overburden deposits left in-situ.
- The use of plant and machinery during construction will require the storage and use of fuels and oils. Their storage and use present potential for spills and leaks which could contaminate underlying exposed soils.
- During construction, imported engineering fill and excavated soils will be exposed in excavations and in temporary stockpiles. These soils will be subject to erosion by wind and rain which could deposit silt in streams with an indirect impact on surface water quality.

The significance of these potential impacts, prior to mitigation, is considered to be **Slight.** The Impact classification is negative, slight significance, permanent, direct and high probability.

Direct impacts to the existing hydrogeological regime associated with the construction of proposed access tracks and hardstands are:

- Potential for groundwater pollution from the removal of overburden deposits. The aquifer underlying the proposed wind farm site is classified by the GSI as ranging from 'Low' to 'Medium' groundwater vulnerability with areas of 'High' and 'Extreme' vulnerability and exposed bedrock present in these areas. It is proposed to remove the overlying topsoil, alluvium and Glacial Till deposits as outlined in the proposed design.
- The vulnerability of the aquifer to groundwater pollution particularly during construction stage will be increased as overburden is removed thus reducing the level of protection from groundwater pollution.
- Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Soil erosion as a result of exposure of soils in open excavations and temporary storage of excavated materials represents a potential impact to the underlying groundwater aquifer.
- Potential for groundwater pollution from the use of cement-based compounds during the construction phase.

The significance of these potential impacts, prior to mitigation, is considered to be **Significant** as underlying groundwater is identified as intersecting with the Blackwater River (Cork/Waterford) Special Area of Conservation**.** The Impact classification is negative, significant significance, permanent, direct and high probability.

9.2.5 Internal Cabling and Grid Connection

Electricity generated from wind turbines shall be collected at medium voltage (20/33kV) by an internal circuit of buried cables which will follow on-site access tracks. This circuit shall terminate at the proposed onsite substation before being exported to the grid via a buried cable to the existing Charleville 110kV substation.

Connection works will involve the installation of ducting, joint bays, drainage and ancillary infrastructure and the subsequent running of cables along the existing road network. The trench will be back-filled and public roads will be reinstated. A similar construction methodology will apply for cable trenches laid within site access tracks. In this case the cable-ducts will generally be laid when the track is being constructed and will follow the edge of the site access tracks. The trenches within these locations will generally be backfilled using the excavated material.

Direct impacts to the existing environment associated with the proposed internal cabling and grid connection works include:

- The proposed grid connection, associated excavations and ducting may present a preferential pathway for the movement of groundwater and/or contamination in the subsurface. However, the subsoil at the proposed development is predominantly Glacial Till which has a low permeability throughout the majority of the proposed grid connection route.
- The excavations for the grid connection trenches and joint bays can have a direct impact on the exposed soils and rock in the form of increased erosion from surface water ingress.
- Where the material excavated from the proposed grid connection excavations are not suitable for reuse as backfill or deposition on site this material will be disposed of at a facility licenced (subject to environmental testing and classification) to accept this waste type.

The significance of these potential impacts on geological receptors, prior to mitigation, is **Slight**. The Impact classification is negative, slight significance, permanent, direct and high probability.

9.2.6 Turbine Delivery Route

The proposed turbine delivery route will be from Foynes County Limerick to the proposed wind farm site. The following accommodation works are required along the Turbine Delivery Route at the following locations. These works do not form part of the proposed development but have been assessed in this EIAR:

- Cut-through at the Clarina Roundabout
- Cut-through at the Mungret Interchange - West Roundabout
- Widening at the Mungret Interchange - East Roundabout
- Local widening at the junction of the N20 and the L1322;
- Local widening along the L1322 from the N20 to the site entrance.

The accommodation works associated with the Turbine Delivery Route will include the excavation of existing overburden deposits. The potential impact would be from the temporary exposure of the overburden to erosion via surface water ingress during the works.

Given the limited extent of excavations associated with these works the magnitude of these potential impacts on geological receptors, prior to mitigation, is considered to be **Not Significant.** The rating of these potential impacts on hydrogeological receptors, prior to mitigation, is considered to be **Significant** as underlying groundwater is identified as intersecting with the Blackwater River (Cork/Waterford) Special Area of Conservation**.**

9.3 Operational Phase

Very few potential direct impacts are envisaged during the operational phase of the wind farm. These include:

- Some construction traffic may be necessary for maintenance of turbines, hardstands and access tracks which could result in minor accidental leaks or spills of fuel/oil.
- The grid 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.

The magnitude of these potential impacts on geological receptors, prior to mitigation, is considered to be **Slight.** The Impact classification is negative, slight significance, short term, direct and low probability. The magnitude of these potential impacts on hydrogeological receptors, prior to mitigation, is considered to be **Imperceptible.** The Impact classification is negative, imperceptible significance, short term, direct and low probability.

A small amount of granular material may be required to maintain access tracks during operation which will place intermittent minor demand on local quarries. The magnitude of these potential impacts, prior to mitigation, is considered to be **Imperceptible.**

9.4 Decommissioning Phase

The potential impacts associated with decommissioning will be similar to those associated with construction but of reduced magnitude.

During decommissioning, it may be possible to reverse or at least reduce some of the impacts caused during construction by rehabilitating construction areas such as turbine bases, hardstanding areas and site compound. This will be done by covering with topsoil 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.

Grid connection cables will be left in the ground, therefore no potential impacts during decommissioning stage are likely to occur.

9.5 Mitigation Measures

9.5.1 Mitigation Measures During Construction

The primary mitigation measure employed has been the design of the wind farm in terms of locating the turbines, access roads, material storage areas and other site infrastructure within an area of agriculture and commercial forestry where the soils are extensively worked and drained. Extensive work has already been undertaken at the preliminary design stage to apply risk avoidance by design which included:

- Excavation of trial pits to establish overburden and bedrock characteristics.
- Shear vane testing to establish characteristic strengths where soft ground deposits were identified.
- Relocation and micro-siting of turbines, hardstandings and access roads based on the site assessments and geotechnical assessments in order to reduce ground risk associated with the proposed development.

A Construction Environmental Management Plan has been prepared for the proposed development. The following mitigation measures are included for Land, Soils and Geology.

Earthworks

The development will be constructed in a phased manner to reduce the potential impacts of the development on the Land, Soils and Geology at the site. Phased construction reduces the amount of open, exposed excavations at any one time. Excavated overburden will be retained on-site and reused as far as possible. This will include:

- Use of suitable site won material (glacial till/bedrock) as general fill in the construction of access tracks, hardstands and in reinstatement around turbine foundations.
- Surplus overburden will be re-used on site in the form of landscaping.

Surplus overburden deposits excavated during the course of the works will be temporarily stored in a level area adjacent to the construction phase excavations prior to reuse.

Some temporary stockpiles (not exceeding 2m in height) of material will be necessary adjacent to the excavation areas prior to reinstatement, however no long-term stockpiles of material will remain after construction and no surplus/waste soil or rock will be removed from the proposed development site.

To mitigate against the compaction of soil at the site, prior to the commencement of any earthworks, the work corridor will be pegged, and machinery will stay within this corridor. Excavations will then be carried out from access tracks, where possible.

To mitigate against erosion of the exposed soil or rock, all excavations will be constructed and backfilled as quickly as possible.

Soil excavated from trenches along the proposed grid connection route will be taken to a licenced facility for disposal or recycling where required. If feasible, the upper layers of tarmac and asphalt will be excavated separately to the lower engineered fill layers. All temporary cuts/excavations will be carried out such that they are stable or adequately supported.

Gravel fill will be used to provide additional support to temporary cuts/excavations where appropriate. Unstable temporary cuts/excavations will not be left unsupported.

Interceptor drains will be installed prior to any construction works commencing. Temporary settlement ponds and silt management measures will be installed to mitigate against sediment run-off as required.

Control of Sediment Laden Runoff

The potential impact from silt laden surface water runoff from increased erosion of exposed overburden deposits will be assessed at site-specific locations particularly at new and existing drainage locations and where earthworks and tree felling are proposed. To minimise the impact to surface water quality, existing drainage will be maintained outside the immediate site area, and where appropriate additional site drainage and settlement ponds will be installed as required prior to construction activities. Silt fencing will be installed in new and existing drainage and monitoring of water quality undertaken during the construction phase.

Measures for Spills

Storage tanks, used to store fuel for the various items of machinery, will be self-contained and double-walled. Refuelling of construction vehicles will be carried out from these tanks or from delivery vehicles at designated refuelling areas. Specific mitigation measures relating to the management of hydrocarbons are as follows:

- Fuels, lubricants and hydraulic fluids for equipment used on the construction site will be carefully handled to avoid spillage.
- Any spillage of fuels, lubricants or hydraulic oils will be immediately contained, and the contaminated soil removed from the site and properly disposed of;
- Waste oils and hydraulic fluids will be collected in leak-proof containers and removed from the site for disposal or re-cycling; and
- Appropriate spill control equipment, such as oil soakage pads, will be kept within the construction area and in each item of plant to deal with any accidental spillage.

Slope Stability

- The works will be designed and supervised by a suitably qualified and experienced geotechnical engineer or engineering geologist, and hydrologist or drainage engineer.
- The works will be designed and supervised by a suitably qualified and experienced geotechnical engineer or engineering geologist, and hydrologist or drainage engineer.
- Drainage infrastructure will be put in place in advance of turbine excavations. Drains will divert surface water and groundwater away from excavations into the proposed surface drainage network. Uncontrolled, direct and concentrated discharges of water onto the ground surface will be avoided.
- Loading or stockpiling on the surface of soft ground will be avoided. Loading or stockpiling on other deposits will not be undertaken without first establishing the adequacy of the ground to support loads by an appropriately qualified geotechnical engineer experienced in construction within upland conditions.

- A detailed assessment of the stability of conditions at proposed infrastructure locations will be undertaken by a suitably qualified and experienced geotechnical engineer prior to the commencement of all excavations to ensure these activities do not result in or contribute to slope failure.
- Excavations which could have the potential to undermine the up-slope component of an existing slope will be sufficiently supported to resist lateral slippage and careful attention will be given to the existing drainage.
- Where possible, earthworks will not be commenced when heavy or sustained rainfall is forecast. A rainfall gauge will be installed on site to provide a record of rainfall intensity. An inspection of site stability and drainage by the Geotechnical Engineer will be carried out on site when a daily rainfall of over 25mm is recorded on site, works will only recommence after heavy rain with the prior approval of the Geotechnical Engineer following their inspection.

Prior to commencement:

- Additional and more extensive ground investigation works are undertaken, and these should be tailored to the engineering requirements of the project.
- The scheme will be developed to full detailed design prior to construction to minimise the risk of ground instability.
- Adequate time is afforded to any designers or contractors involved in the execution of the additional ground investigation works; detailed design and construction works.

Groundwater

To mitigate against the increased vulnerability of the underlying aquifer to groundwater pollution, all excavations will be constructed and backfilled as quickly as possible. Excavation will stop during or prior to heavy rainfall. Refuelling of machinery and plant will only occur at designated refuelling areas.

To monitor groundwater during the construction phase groundwater monitoring wells will be installed between areas of deeper excavations and sensitive groundwater receptors. The wells will be used to monitor groundwater levels and quality to assess any potential impacts during the construction works.

Grid connection and internal cable trenches could provide preferential pathways for groundwater and contaminant movement. Trenches will be excavated during dry periods where possible in short sections and left open for minimal periods, to avoid acting as a conduit for surface water flows. To further mitigate the risk of cable trenches becoming preferential pathways, clay plugs (or other low permeability material) will be installed at intervals along the trench to stop/inhibit water movement.

9.5.2 Mitigation Measures During Operation

It is not envisaged that the operation of the proposed development will result in significant impacts on the geological and hydrogeological regimes within the study area, as there will be no further disturbance of overburden post-construction.

The main potential residual impact during the operation phase would be the risk to groundwater from contamination from spills. Storage tanks, used to store fuel for the various items of machinery, will be self-contained and double-walled.

Refuelling of maintenance vehicles will be carried out from these tanks or from delivery vehicles at designated refuelling areas. Specific mitigation measures relating to the management of hydrocarbons are as follows:

- Fuels, lubricants and hydraulic fluids for equipment used on the site will be carefully handled to avoid spillage.
- Any spillage of fuels, lubricants or hydraulic oils will be immediately contained, and the contaminated soil removed from the site and properly disposed of;
- Waste oils and hydraulic fluids will be collected in leak-proof containers and removed from the site for disposal or re-cycling; and
- Appropriate spill control equipment, such as oil soakage pads, will be kept within the refuelling areas and in each item of plant to deal with any accidental spillage.

Due to the reduced magnitude of the impacts, no additional mitigation measures are required for the maintenance and operation of the wind farm, over and above those incorporated into the design of the substation transformer, which will be bunded to protect soils against accidental leakages of oils and battery fluids.

9.5.3 Mitigation Measures During Decommissioning

Mitigation measures applied during decommissioning activities will be similar to those applied during construction where relevant.

Some of the impacts associated with reinstatement of the site (excavation of turbine bases, access tracks etc.) will be avoided by leaving these in place where possible. The Irish Wind Energy Association (IWEA) (11) states that when decommissioning a wind farm “the concrete bases could be removed, but it may be better to leave them under the ground, as this causes less disturbance”. It is proposed to leave the access tracks in-situ at the decommissioning stage. IWEA also state that “it may be best” to leave site tracks in-situ depending on the size and geography of the development.

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. It is proposed to retain these elements of the construction and cover with overburden material to allow for re-vegetation of the development site.

Removal of this infrastructure would result in considerable disruption to the local environment in terms of increased sedimentation, erosion, dust, noise, traffic and an increased possibility of contamination of the local water table. However, if removal is deemed to be required by the respective local authority all infrastructure will be removed with mitigation measures similar to those during construction being employed.

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.

10. HYDROLOGY AND WATER QUALITY

10.1 Existing Environment

The proposed Annagh wind farm is situated within the Awbeg (Buttevant)_SC_010 sub-catchment as defined by the Water Framework Directive. This sub-catchment is part of the Blackwater Munster (ID 18) catchment. The wind farm site is situated within two sub-basins. These waterbodies are:

- Awbeg (Buttevant)-West_020 (IE_SW_18A090400) and
- Oakfront_010 (IE_SW_18O120820).

Turbines T1, T3 and T6 are within Oakfront_010 sub-basin. Turbines T2, T4 and T5 are within Awbeg (Buttevant) West_020 sub-basin.

The cable route between the proposed on-site substation and existing 110kV substation at Charleville is within 2 sub-basins. These are:

- Oakfront_010 (IE_SW_18O120820),
- Awbeg (Buttevant)_010 (IE_SW_18A050550).

The main hydrology features within the wind farm site are the Ardglass Stream and Oakfront Stream which drain into the River Awbeg (Buttevant) West c.1.3km downstream of the site, with this river being part of the Blackwater River (Cork/Waterford) Special Area of Conservation. The wind farm site is drained by forestry and field drains which ultimately join the Oakfront Stream. There are no lakes or reservoirs within the wind farm site study area. According to the Preliminary Flood Risk Assessment maps, the proposed wind farm site is prone to fluvial flooding.

One main stream crossing is located at the wind farm site over the Oakfront Stream. A stream crossing is also located along the grid connection route at the Rathnacally Stream.

10.2 Potential Impacts

The potential impacts on the hydrological regime are associated with the activities associated with each phase (construction, operation and decommissioning) of the proposed project. The conventional source-pathway-target model was applied to assess potential impacts on downstream environment receptors as a result of the proposed project.

10.2.1 Construction Phase

Unmitigated Increase in Surface Runoff

During the construction period, the project has the potential to lead to impacts on hydrology and water quality unless appropriate mitigations are applied. Inappropriate construction practices could also have the potential to impact the water quality and WFD status of existing waterbodies, which includes the Blackwater River (Cork/Waterford) SAC.

Tree felling, new access tracks and upgrade of existing agricultural tracks, turbine hardstanding areas, the on-site substation all have the potential to contribute to the increase in runoff.

The estimated peak runoff from the wind farm site was calculated using Rational Equation (RE) for pre and post-construction scenario for 1 in 100 year storm event. The difference between these two values is equal to an increase in the peak runoff resulted from changes in the surface at hardstanding area around turbines, access roads and substation.

The peak runoff for RE equation occurs for a storm event with duration equal to the time of concentration. Time of concentration at the location of the main wind farm site is estimated to be 60min. Therefore, the estimated increase in runoff was calculated for a 1-in-100 year storm event with a duration of 60 minutes. This equates to rainfall with an intensity of 36.3 mm/h. The intensity is increased by 20% for Mid-range future climate change scenario (MRFS). The overall estimated increase in the unmitigated peak runoff due to the wind farm is 0.174 m3/s (or 0.20 %) for a 1 in 100 years storm event. The significance of the effect of the increase in runoff is “Not Significant” on receiving waters because estimated increases in the peak runoff is low compared to the flows of receiving waters and not being concentrated at one point. This is without taking account of mitigation measures that will be put in place to slow runoff down within the proposed wind farm drainage system.

Suspended Solids

The activities associated with construction of the wind farm site will require earthworks. Potential sources of sediment laden water include:

- Standing water in excavations could contain an increased concentration of suspended solids.
- Haul roads passing close to watercourses could allow the migration of silt laden runoff.
- Silt carried on the wheels of vehicles leaving the construction site could be carried onto the public road.
- A blockage in the proposed roadside drains could allow a break out of silt laden runoff to reach adjacent watercourses or streams.
- Overland flow entering excavations could increase the quantity of surface water to be treated for sediment removal.
- Inappropriate management of excavations could lead to loss of suspended solids to surface waters.
- Inappropriate storage and management of the excavated material could lead to loss of suspended solids to surface waters.
- Surface water inflows and minor groundwater seepages may occur in turbine base excavations. Surface water inflows can occur following a rainfall event. Pumped water from the pits will most likely contain suspended solids.

- To accommodate the access to the locations of the proposed turbines, a total of 14 crossings over the watercourses will be constructed or reconstructed. During the construction there is a potential to release suspended solids into the watercourse. Works leading to erosion of the river banks/bed could result in the release of suspended solids.
- Tree felling could lead to an increase in sediment in the surface water runoff, if the brash is left in place in the riparian buffer zones.

These activities can result in the release of suspended solids to surface watercourses and could result in an increase in the suspended sediment load, which in turn could affect the water quality and fish stocks of downstream water bodies if the appropriate mitigation measures are not put in place. The significance of the effect of the release of suspended solids into the receiving waters is "**Significant**".

Release of Hydrocarbons

- Refueling activities could result in fuel spillages which could pollute underground and surface water, especially during the construction of new culverts/bridges.
- There is the potential for fuel spill/leaks from storage tanks which will be stored on main wind farm site for plant machinery. Fuel spill/leaks could infiltrate underground and pollute underground water. Fuel spills/ leaks could be drained to watercourses and pollute them.
- Tree felling process require trafficking of heavy machinery which can lead to pollution of watercourses due to spillage of fuels and hydrocarbons.

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. The significance of the effect of the release of the hydrocarbons into the receiving waters is "**Slight**" due to the low likelihood and low quantities involved.

Contamination from Wastewater and Pollutants

- Sanitary waste could lead to contamination of receiving waters.
- Crayfish plague is a pathogenic water mould which can kill crayfish. It can be spread on contaminated equipment.

Release of effluent from domestic wastewater treatment systems has the potential to impact receiving water. The significance of the effect of the release of sanitary waste into the receiving waters is "**Slight**" because it is unlikely that a large amount of sanitary waste could be released into the environment.

Release of Cement-Based Products

Cement based product will be used in turbines foundation and substation. Precast structures will be used for watercourse crossings with the exception only of construction of bridge abutments.

- Cement-based products could lead to contamination of receiving waters and groundwaters.

Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative impacts on water quality. Entry of cement based products into the site drainage system, into surface water runoff, and to surface watercourses or directly into watercourses represents a risk to the aquatic environment. Wet concrete and wash out of transport and placement machinery are the activities most likely to generate a risk of cement based pollution. The significance of the effect of the release of the cement based products into the receiving waters is "**Moderate**" because it is unlikely that a large amount of cement based products could be released into the environment.

Potential Impacts from Tree Felling

It is estimated that 12.6 ha in total of existing forestry will be felled to allowed for development of the proposed wind farm infrastructure.

- Potential impacts related to suspended solids
- Excessive haulage distances to roads, leading to site soil damage
- Rutting and compaction through the overuse of tracks
- Tree felling could lead to an increase in sediment and nutrients in the surface water runoff, if the brash is left in place in the riparian buffer zones.
- During clear-felling there is a higher potential for nutrient loss as there are no living tree roots left to take up the nutrients. Any organic matter (particularly recently dead material such as brash or roots) that is left on site to rot will release phosphorus and nitrogen. Decaying brash resulting from the clear-fell can generate nutrients which could potentially lead to nutrient enrichment of any small first order streams. The breakdown of brash, roots and other organic matter takes a number of years.

In Ireland, forestry is an activity that operates under strict environmental controls such as tree felling licences and also principles of sustainable forest management with great emphasis on the protection of the aquatic environment. The significance of the effect of the potential release of nutrients into the receiving waters is "**Moderate**".

Potential Impacts Associated with Construction of Grid Connection

The following potential impacts could result from the construction activities related to grid route installation and watercourse crossings:

- Suspended solids drained to watercourse could potentially lead to siltation and physical effect on flora and fauna.
- Excavated soil could be mobilised in the surface water runoff during an extreme rainfall event.
- The excavation of trenches for cable laying, and the launch and reception areas for directional drilling, could lead to silt laden surface water run-off.
- Inadequate storage of fuels and oils could lead to contamination of surface water.
- Refuelling activities could result in fuel spillage.
- Works leading to erosion of the riverbanks/bed could negatively impact on the fisheries habitat.
- Drilling fluids associated with HDD works could pollute watercourse.
- Sediment laden runoff during the launch pit and reception pit excavation works.

These activities can result in the release of suspended solids to surface watercourses and could result in an increase in the suspended sediment load, which can affect the water quality and fish stocks of downstream water bodies. The significance of the effect of the release of suspended solids into the receiving waters is "**Slight**".

Potential Impacts Associated with Turbine Delivery Route Works

Modifications along the TDR involves the temporary removal of street furniture and removal of some vegetation in addition to the temporary local widening at bends using hardcore material. These are small local areas, therefore it is not anticipated that this will have any significant hydrological impact.

At Node 10.5, vegetation on the northern side of the Rathnacally Stream will be cut and the wall of the nearby pump enclosure will be lowered by 0.5m. Pump enclosure is approximately 25m from the watercourse. There is a potential for release of sediments and debris into the stream. There is also a potential for oil leakage from machinery and equipment that will be used. Due to the small extent of the wall which will be removed and vegetation that will be cut, it is concluded that the potential for effect from the works associated with TDR on the receiving waters is "**Not Significant**".

10.3 Operational Phase

Due to the grassing over the drainage swales and revegetation of other exposed surfaces, and the non-intrusive nature of operations, there is a negligible risk of sediment release to the watercourses during the operational stage. During the operation stage, small quantities of oil will be used in cooling the transformers associated with the facility. There is therefore a potential for small oil spills. The significance of the effect of the potential for small oil spills into the receiving waters is **"Not Significant"**.

10.4 Decommissioning Phase

The decommissioning activities will take place in a similar fashion to the construction phase. Potential impacts will be similar to the construction phase but to a lesser degree. There will be increased trafficking and an increased risk of disturbance to underlying soils at the wind farm, during the decommissioning phase.

Any such potential impacts would be likely to be less than during the construction stage as the drainage swales would be fully mature and would provide additional filtration of runoff. Any diesel or fuel oils stored on main wind farm site will be bunded.

For access tracks and turbine hard standings it is proposed that they are left in place. The foundations will be covered over and allowed to re-vegetate naturally. Removal of this infrastructure would result in considerable disruption to the local environment in terms of an increased possibility of sedimentation. It is considered that leaving the turbine foundations hardstanding areas in-situ will cause less environmental damage than removing them.

Grid connection infrastructure including substations and ancillary electrical equipment shall form part of the national grid and will be left in situ.

Therefore, it is concluded that the potential impact on hydrology and water quality during decommissioning stage is 'Not Significant'.

10.5 Mitigation Measures

10.5.1 Construction Phase Mitigation Measures

Permanent roadside drainage will be installed as part of the construction stage. This will include the use of interceptor drains, swales and check dams. The proposed drainage system will increase time of concentration. Time of concentration is time required for an entire catchment to contribute to runoff at the point of interest. These measures will buffer site runoff during periods of high rainfall by retaining the water. Given the increase in runoff due to the construction of the wind farm is 0.174 m3/s (or 0.20%), not significant residual effects are anticipated.

The key mitigation measure during the construction phase is locating the proposed turbines 50m from the watercourse. No construction activities or drainage will be within 50m of the watercourses, with an exception for watercourse crossings, access road leading to the proposed substation and turbine T4. The proposed buffer zones will:

- Avoid physical damage to watercourses, and associated release of sediment.
- Avoid excavations within close proximity to surface water courses.
- Minimise the potential for the entry of suspended sediment from earthworks into watercourses.
- Minimise the potential for 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.

The following measures shall be implemented during the construction phase:

- settlement ponds with a diffuse outflow detail will be put in place in advance as construction progresses across the site. Erosion control and retention facilities, including settlement ponds will be regularly maintained during the construction phase. The three-stage treatment train (swale – settlement pond – diffuse outflow) proposed to retain and treat the discharges from hard surface areas as a result of the development will reduce any risk of flooding downstream.
- A water quality monitoring programme will be established to ensure that water quality is maintained throughout the construction phase. The details of this programme are outlined below. This programme will ensure that designed measures including settlement ponds are working, and existing water quality is maintained.
- It is proposed to divert an existing field drain adjacent to Turbine number 4. The diversion of the field drain will take place during a dry period. It is proposed to put double silt fences in the drain just upstream and downstream of the diversion area. Prior to construction is it proposed to build a small stone dam within a ditch to prevent water ingress. Clean water accumulated upstream of a dam will be pumped downstream of the construction area.
- Where haul roads pass close to watercourses, silt fencing will be used to protect the streams.
- Silt traps will also be provided at outfalls from roadside swales to settlement ponds.

- Interceptor cut-off drains will be provided on the upslope side of the access roads to prevent the mixing of overland flows with the drainage for the proposed development. These interceptor drains will discharge diffusely over land to avoid concentration of runoff.
    - The roadside drains will therefore only carry the site access road runoff and so avoid carrying large volumes of water and concentrating flows.
- Where new cross-drains are proposed on this site to convey surface water from roadside swales to settlement ponds, these will be sized at a minimum of 300 mm diameter to avoid blockages.
- Cross drains of 450 mm will be provided to prevent a risk of clogging for drainage crossings and conveying flow from agricultural drains and forestry drains under access track roads.
- Standing water, which could arise in excavations, has the potential to contain an increased concentration of suspended solids as a result of the disturbance to soils. The excavations for turbines will be pumped into the site drainage system (including settlement ponds), which will be constructed at site clearance stage, in advance of excavations for the turbine bases.
- All open water bodies adjacent to proposed construction areas will be protected by fencing including the proposed settlement ponds.
- Excavated subsoil material not required for in-site reinstatement will be removed to the designated material storage areas.
- Silt fencing will be erected at the locations of the drain crossings for the duration of the construction period.
- Site access tracks have been laid out to reduce slope of roadside drains where possible. Where roadside drains are laid at slopes greater than 2%, check damns will be provided. This will reduce effective slope and runoff velocities and any consequent potential for erosion.
- Silt fencing will be erected at the location of stream crossings along the cable route.
- The temporary storage of excavated material on site will be put at least 50 m from watercourses.
- An Environmental Clerk of Works will be appointed by the developer to ensure the effective operation and maintenance of drainage and other mitigation measures during the construction process. The operations management of the Site will include regular monitoring of the drainage system and maintenance as required.
- Additional protection will be provided in the form of silt fencing downslope during construction of new watercourse crossings, to further ensure that there is no impact from the development to streams and rivers downslope of the site. All open water bodies adjacent to proposed construction areas will be protected by fencing.
- Daily visual inspections of drains and streams will be performed during the construction period of the new crossing structures to ensure suspended solids are not entering the streams and rivers alongside the work area, to identify any obstructions to channels, and to allow for appropriate maintenance of the existing roadside drainage regime.
- Weather warnings will be monitored, and no construction will take place during extreme events. Large excavations and movements of 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. Prior to works being suspended the following control measures will be completed:
    - Secure all open excavations.
    - Provide temporary or emergency drainage to prevent back-up of surface runoff.
    - Avoid working during heavy rainfall and for up to 24 hours after heavy rainfall events to ensure drainage systems are not overloaded.

- 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.
- Brash mats will be used to support vehicles on soft ground. 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. Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall.

A monitoring programme will be established to ensure that water quality is maintained. This programme will ensure that designed measures are working, and water quality is not affected.

The main hydrological impact of the project is an increase in runoff. This is mitigated by the drainage system. It is anticipated that the drainage system will increase time of concentration and consequently the peak runoff will be decreased. The drainage system will be left in-situ during operational stage.

Release of Hydrocarbons

- Refueling of plant during construction will only be carried out at designated refueling station locations on site.
- Storage of fuels, lubricants and hydraulic fluids will occur at the contractor's compound, which will be fenced and have a lockable gate, thereby ensuring that the area in which fuels, lubricants and hydraulic fluids are stored will be properly secured against unauthorized access or vandalism.
- Emergency drip trays and spill kits will be kept available on site, to ensure that any spills from vehicles are contained and removed off site. The emergency response procedure is provided in the SWMP provided in Appendix 10.3.
- Designated contractors' personnel will be trained and certified in oil spill control and clean up procedures, and in the proper and safe disposal of any waste generated through such an event.
- Any diesel, fuel or hydraulic oils stored on site will be stored in bunded storage tanks – the bund area will have a volume of at least 110 % of the volume of such materials stored.

Contamination from Wastewater and Pollutants

- Portaloos and/or containerised toilets and welfare units will be used to provide toilet facilities for site personnel. Sanitary waste will be removed from site via a licenced waste disposal contractor.
- To reduce the risk of invasive species and pathogen introduction (e.g. Crayfish plague), all equipment will be thoroughly checked, cleaned and dried in accordance with best practice as specified in the CIRIA guidelines below. Furthermore, plant machinery which has worked within a river corridors or come in to contact with water will be steam-cleaned and dried in advance of works commencement in the Blackwater catchment.

Release of Cement-Based Products

- Prior to leaving the site, every truck delivering concrete to the site must wash the chute only to a lined pit provided at each turbine location and substation compound.

- There will be no on-site batching of concrete and no storage of cement will be permitted within 50 m of the crossing construction areas, except at turbine number 04 (T04).
- During all concrete works pH will be measured daily upstream and downstream of works areas. A change in 0.5 pH units will trigger cessation of works and investigation of possible concrete source.
- Where possible, pre-cast elements will be used to minimise the need for wet concrete works within the site.
- Weather forecasting will be used to plan dry days for pouring concrete.
- It will be ensured that the concrete pour site is free of standing water prior to concreting and plastic covers will be available in case of a sudden rainfall event.

Proposed Mitigation Measures for Tree Felling

Tree felling will be permitted under limited felling license(s) from the Forest Service and to the conditions of such a license. It will be carried in in line with policy and guidance.

The following mitigation measures are proposed:

- Before operation commence, identify a 10m wide exclusion zone along the edge of all aquatic zones
- Ensure all operators are aware of exclusion zone
- Machine traffic and timber stacking are not permitted within these zones
- Trees within the reach of the harvester arm will be felled by harvester, and snedded and bunched outside the exclusion zone.
- Trees outside machine reach to be felled manually by chainsaw operators. Felled trees to be winched out of the exclusion zone where appropriate and safe to do so, or removed by extended harvester arm, for subsequent snedding and processing outside the exclusion zone.
- In all cases, fell trees away from the water feature.
- Regarding aquatic zones, ensure banks remain undisturbed. No branches or debris are to enter the aquatic zone during operations. Immediately and with care, remove any branches that do fall in.
- Minimise the crossing of drains during felling and extraction, and restrict machine activity to brashed extraction racks and haulage routes.
- Where necessary, deploy a heavy-duty plastic culvert lengthways into the channel and cover with brash material. The culvert must be of a diameter approximating the depth of the drain, to avoid any unnecessary undulation along the extraction route.
- Where required, a solution for smaller drains is to temporarily lay log sections lengthways into the channel and overlay with brash. Again, select logs that approximate the depth of the channel to be crossed.
- When installing and removing the temporary crossing, ensure that no work is carried out within the aquatic zone, and that the stream bed and bankside remain undisturbed.
- Carefully remove temporary crossings as they become no longer needed. Any brash padding used must be peeled back carefully away from the water feature, to avoid dislodging collected sediment.
- Direct crossing over the stream bed is not permitted.
- Ensure the feature is crossed at a right angle to the flow of water.

- Where needed, any necessary crossing shall be via an appropriate structure that spans proud of the flow of water and prevents the breakdown and erosion of the banks.
- Solutions include the laying down of a bridge comprising logs overlaid with geotextile and brash to intercept soil falling off wheels.
- 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.
- Timber will be stacked in dry areas, and outside a local 50m watercourse buffer. Straw bales and check dams will be emplaced on the down gradient side of timber storage sites.
- Brash mats will be used to support vehicles on soft ground (e.g. during trenching and drainage construction), 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. Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall.
- Prior to the commencement of operations, silt traps will be installed within existing forest drains that connect with aquatic zones, either directly or indirectly through other relevant watercourses.
- Silt traps will be staggered along the length of the drain, and not only at the lower reaches towards its outflow.
- Silt trap design can vary, from depressions added to the drain bed, to log sections laid lengthways into the drain, to the use of geotextile barriers
- Silt fences will be utilized where necessary, to block pathway for silt in areas where overland flow is possible.
- Once silt traps and silt fences become functional, they will be regularly checked and maintained as necessary, in order to ensure continued effectiveness throughout operations.
- Felling and extraction and other machine operations onsite (or redirect to more stable areas of the site) will cease during and after periods of rainfall which result in the possibility of the surface mobilisation of silt.
- At least weekly check Silt traps and silt fences will be checked weekly, and maintained as required, to ensure their continued effectiveness throughout works. All excess silts will be removed and disposed of appropriately.
- Daily visual checks will be undertaken of relevant watercourses (primarily at their outflow from the site) and adjoining aquatic zones, to confirm (or otherwise) that no sediment or silt discharge will be arising from site works.
- A record will be kept of the above monitoring, and retain for possible inspection.

Proposed Mitigation Measures During Grid Connection and Horizontal Directional Drilling

- Cables will be installed in trenches adjacent to the site access roads or laid within the access road carriageway corridor, where required. Trenches will be excavated during dry periods in short sections and left open for minimal periods, to avoid acting as a conduit for surface water flows.
- The temporary storage of excavated material on site will be put at least 50 m from watercourses as detailed in soil management plan provided in CEMP. Please refer to Appendix 3.1.

- Weather warnings will be monitored and no construction will take place during extreme events to mitigate against potential flooding.
- Any excavated material will be used in the reinstatement of the cable trenches subject to approval. Unsuitable surplus material will be removed from the site to an appropriate licenced facility. For trenching within the domain of public roads, approved fill material will be imported in accordance with the method statement described in Section 3.
- All excavated soil material will be managed on site in accordance with the CEMP provided in Appendix 3.1.
- Silt fencing will be provided around any exposed areas to prevent the ingress of suspended solids into adjacent watercourses. These mitigation measures will prevent surface water contamination and will prevent subsequent flows of contaminated water into watercourses.
- Refueling of plant during construction will only be carried out at least 50m from any open water body.
- Storage of fuels, lubricants and hydraulic fluids will occur at the contractor's compound, which will be fenced and have a lockable gate, thereby ensuring that the area in which fuels, lubricants and hydraulic fluids are stored will be properly secured against unauthorized access or vandalism.
- Emergency drip trays and spill kits will be kept available on site, to ensure that any spills from vehicles are contained and removed off site. The emergency response procedure is provided in SWMP provided in Appendix 10.3.
- Designated contractors' personnel will be trained and certified in oil spill control and clean up procedures, and in the proper and safe disposal of any waste generated through such an event.
- Any diesel, fuel or hydraulic oils stored on site will be stored in bunded storage tanks – the bund area will have a volume of at least 110 % of the volume of such materials stored.

10.5.2 Operational Phase Mitigation Measures

When operational, the project will have a negligible effect on surface water quality as there will be no further disturbance of soils post-construction.

The following mitigation measures are proposed for replacing or removal of the wind turbine blades:

- Emergency drip trays and spill kits will be available on main wind farm site, to ensure that any spills from vehicles are contained and removed off site.
- Refuelling or maintenance of machinery will not occur within 50m of a watercourse. Mobile bowser, drip kits, qualified personnel will be used where refuelling is required.

During the operation stage, small quantities of oil will be used in cooling the transformers associated with the facility. There is therefore a potential for small oil spills. Risks of potential oil leakage and pollutions draining to the watercourse from the installed transformer is mitigated with transformer interceptor bund wall.

It is not envisaged that the maintenance period will involve any significant impacts on the hydrological regime of the area. The maintenance will incorporate effective maintenance of the drainage system. The maintenance regime will include inspecting the following post extreme storm event:

- Drains, cross-drains and culverts for any blockages
- Outfalls to existing field drains and watercourses

- Roadside swales for any obstructions
- Swales
- Progress of the re-establishment of vegetation.

The maintenance regime will also include implementing appropriate remedial measures as required after the above inspections and testing the water quality at the outfalls at appropriate intervals. Visual inspections will be undertaken during the maintenance period. With mitigation measures being applied, it is anticipated that there will be a 'not significant' impact on hydrology and water quality during Operation and Maintenance stage of the project.

10.5.3 Decommissioning Phase Mitigation Measures

During decommissioning of the wind farm site, the access tracks will be used in the decommissioning process. Drainage system will be fully functional. Mitigation measures applied during decommissioning activities will be similar to those applied during construction but will be of reduced magnitude.

For the access tracks and turbine foundations it is proposed that they are left in place and covered with local soil/topsoil at decommissioning stage. It is considered that leaving the turbine foundations, access tracks and hardstanding areas in-situ will cause less environmental damage than removing them.

The grid connection ducting and substation will be left in situ as part of the national grid, therefore no potential impacts during decommissioning stage are likely to occur. Hence no mitigation measures are required.

With mitigation measures being applied, it is anticipated that there will be a 'not significant' impact on hydrology and water quality during Decommissioning stage of the project.

11. POPULATION, HUMAN HEALTH AND MATERIAL ASSETS

11.1 Population

The general area of the proposed Annagh Wind Farm is rural in nature, and dominated by agricultural enterprise, with a low population density when compared to the averages of the State and County Cork. Overall, the receiving area has a low population density (26.3 persons per square kilometre) due to its rural nature and low density 'one-off' house settlement pattern. There are 73 no. dwelling located within 1.5km of the turbine locations . Of these 73 dwellings, 16 no. are also registered as commercial (farmsteads). There are no permitted dwellings yet to be constructed within 1.5km of the proposed turbine locations. There are 30 no. dwellings located along the proposed Grid Connection Route.

11.1.1 Potential Impacts on Population

Construction Phase

The potential impacts on population and demographic trends arising from the proposed project during its construction phase relate to potential population increase or decrease. This will give rise to short-term/brief population growth at the wind farm site during working hours. This is associated with the direct employment of construction workers, trades people, labourers and specialised contractors. The construction phase of the wind farm site has potential to create between 39 and 44 jobs.

It is unlikely that permanent effects to population at the Wind Farm Site, Grid Connection Route or Turbine Delivery Route will occur, in terms of changes to population trends or population density as a result of the construction phase.

Operational phase

Once constructed, it is envisaged that there will be direct and indirect employment associated with the operational phase of the proposed project. Opportunities for mechanical-electrical contractors and craftspeople to become involved with the operation and maintenance of the project will arise, with between 12 and 14 long term jobs being created. Although only a small proportion of these jobs are likely to be based in the Wind Farm Site, the operational phase will give rise to temporary, slight population increase at the wind farm site during working hours as a result of operations and maintenance occurring at the site. This effect is expected to be brief and imperceptible.

Decommissioning phase

A construction crew will be required for dismantling the infrastructure and carrying out remediation where necessary. As the decommissioning of the project is expected to be less intensive than the construction phase, it is likely that less construction workers will be required for this phase. During the decommissioning phase, the population of the Wind Farm Site will increase daily during working hours and return back to normal outside of working hours.

11.1.2 Mitigation Measures - Population

As there are no significant effects predicted on population trends and population density, no mitigation measures are required.

11.2 Socio-economics, Employment and Economic Activity

The wind farm site, grid connection area and turbine delivery route areas have a similar economic profile to that of County Cork and the State.

11.2.1 Potential Impacts – Socio-economics, Employment and Economic Activity

Construction Phase

The construction phase of the proposed development will have a short-term, significant positive effect on the employment profile of the Study Area and a short-term slight, positive effect on local businesses and services in the nearby towns and villages in proximity to the Study Area.

It is estimated that between approximately 39 and 44 staff/contractors could be employed during the construction phase of the proposed project. Furthermore, local businesses in the nearby towns of Charleville, Buttevant and Mallow and villages including Churchtown, Ballyhea, Liscarroll and Dromina will likely receive a slight indirect positive economic impact due to the influx of workers to the area who will require services such as shops and food places.

Operational Phase

Once constructed, it is envisaged that there will be direct and indirect employment associated with the operational phase of the proposed project. Opportunities for mechanical-electrical contractors and craftspeople to become involved with the operation and maintenance of the project will arise.

It is expected that the operational phase of the proposed development (wind farm site) could create between 12 and 14 long term jobs. It is likely that only a small proportion of these jobs are likely to be based in the Wind Farm Site.

Rates and development contributions paid by the developer will contribute significant funds to Cork County Council which will likely be used to improve the services available to the people of the County.

A community benefit fund of approximately €180,000 per annum for the first 15 years of the project will be distributed around the local community. The provision of the Community Benefit Fund will have a significant long-term, positive effect on the socio-economic profile of the study area and wider area.

Following a review of studies carried out internationally, 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 and will therefore have a long-term imperceptible impact.

Decommissioning Phase

The decommissioning phase of the proposed project provides for the removal of turbines and associated infrastructure from the site. The potential effects associated with the decommissioning phase in relation to employment will be similar to that of the construction phase but at a reduced magnitude.

11.2.2 Mitigation Measures - Socio-economics, Employment and Economic Activity

Given that potential effects of the proposed development at construction, operation and decommissioning phases are predominantly positive in respect of socio-economics, employment and economic activity, no mitigation measures are considered necessary.

11.3 Land Use

The proposed Wind Farm site is located in an area of private agricultural lands with areas of commercial broadleaf forestry throughout. There are 75 dwellings located within 1.5km of the proposed turbines. There are two wind farms located in proximity to the site. These consist of the Boolard Wind Farm (2 wind turbines) and the Rathnacally Wind Farm (2 wind turbines). There is a quarry located approximately 2.5km east of the wind farm site. The closest settlement is the village of Churchtown, located approximately 2.5km to the south. The proposed Grid Connection Route will be installed in the public road. Land use observed along the grid route consists of arable and pasture farmlands, one-off houses and farmsteads, and the Dawn Meats Factory.

The Turbine Delivery Route begins at Foynes Port in County Limerick. The route follows the national road network, passing by residential dwellings and businesses and passing through small villages. The Turbine Delivery Route passes through Charleville Town Centre which consists of a range of residential, industry, commercial premises and town centre services. The TDR then enters onto local roads on the approach to the wind farm site on the L1322 at Ballyhea. Land use along this section is similar to the grid connection route.

11.3.1 Potential Impacts – Land Use

Construction Phase

The existing land-uses in proximity to the proposed Annagh Wind Farm will remain broadly unchanged during the construction phase of the project, however, some land use in close proximity to the site will be temporarily disrupted during the construction phase as a result of construction activity. There are 4 no. proposed wind turbines and associated hardstandings located within commercial forestry areas or partly in forestry areas. The remainder of the proposed development at the wind farm site is located on agricultural lands. A section of the proposed site entrance at the north of the site is located adjacent an existing dwelling which will result in the loss of approximately 0.1 hectares of private open space. Felling of approximately 12.6 hectares of broadleaf forestry is required within and around the wind farm infrastructure to accommodate the construction of the turbines.

Temporary effects on land use will arise as a result of the installation of the grid connection along the grid route which will be constructed within the public road corridor. Full road closures will be put in place to facilitate cabling works in combination with lane closures, partial road closures and stop/go systems. Turbine Delivery Route node upgrade activity has potential for slight, brief to temporary impacts to land use in proximity to each node.

Operational Phase

It is anticipated that there will be minimal impact on existing land uses arising from the operational phase. The operational phase of the Annagh Wind Farm will result in a change of land use in areas where access tracks, turning heads wind turbine bases, hardstanding areas, met mast, substation, and drainage infrastructure will be located. The lands affected are currently in use for agriculture and commercial forestry. The area of lands which will change use from open field agricultural use to wind farm use will be approximately 4 hectares. The area of forestry to be removed is 12.6 hectares. Farming activity can continue at the site during the operational phase. Forestry will be replanted off-site at Emlagh, County Clare. Activity is not expected at the Grid Connection and Turbine Delivery Route during the operational phase of the proposed project.

Decommissioning Phase

The potential effects associated with the decommissioning phase in relation to land use will be similar to those associated with construction phase but of a reduced magnitude. The decommissioning works will require a construction crew on-site and may cause temporary disruption to surrounding land uses. Removal of infrastructure from the site may temporarily affect forestry and agricultural practices. The proposed new and upgraded access tracks will be used for agricultural and forestry activity following decommissioning providing a direct benefit.

The underground grid connection will remain in situ following decommissioning and form part of the national grid.

11.3.2 Mitigation Measures – Land Use

Mitigation measures for land use are primarily related to preliminary design stage, which has allowed for the prevention of unnecessary or inappropriate ground works or land use alterations to occur. The construction and operational footprint of the proposed development has been kept to the minimum necessary to avoid negative effects on existing land uses as so far as possible. The construction and decommissioning works will be planned and controlled by a Construction and Environmental Management Plan. Communication of the proposed works will be undertaken with the public. Prior to the grid connection installation works within public roads, it is proposed that all access points (domestic, business, agriculture) are considered when finalising the temporary road closures and diversions, in order to maintain local access as much as possible and avoid impacts on various land uses.

11.4 Recreation, Amenity and Tourism

Top attractions in the Cork area in 2019, listed by Fáilte Ireland, include Blarney Castle, Doneraile Park and Fota Wildlife Park, which are 42km, 13km and 52km from the proposed wind farm site, respectively. Other recreation and tourism amenities located in the area of the proposed wind farm include:

- Ballyhoura Way, ca. 2km from the wind farm site.
- Churchtown GAA Club, ca. 3km from the wind farm site.
- Charleville Gold Club, ca. 4km from the wind farm site.
- Dromina GAA Club, ca 4km from the wind farm site.

- Ballyhea GAA Club, ca. 4km from the wind farm site.
- Charleville GAA Club, ca. 5km from the wind farm site.
- Charleville Playground and Pitch & Putt Club, ca. 5km from the wind farm site.
- Newtownshandrum GAA Club, ca. 5km from the wind farm site.
- Ballyhoura Mountains (trails walking), ca. 6km from the wind farm site.

Overall, the most significant recreation activity/attractions in proximity to the Annagh Wind Farm site is trail walking, mountain biking, equestrian activity and sports grounds. . The most proximate national monuments to the wind farm site are Liscarroll Castle and Ardskeagh Church, both located approximately 7km from the site. The Ballyhoura Way passes approx. 2km south of the site running east to west. The route is a National Waymarked Trail long-distance trail measuring approx. Community facilities and services in the greater area include food places, public houses, convenience stores, guest houses, nursing homes, schools, churches, GAA clubs and sports grounds.

11.4.1 Potential Impacts – Recreation, Amenity & Tourism

Construction Phase

There are no significant tourism attractions located in proximity to the proposed Annagh Wind Farm site, grid route and TDR, and as such, the construction phase of the proposed development is not expected to impact on major tourism attractions, tourism numbers or tourism revenue.

Operational Phase

From a review of literature it is indicated that the majority of tourists surveyed in Ireland and Scotland had a generally positive view on wind energy development in the landscape. The most proximate major tourist attraction to the Annagh Wind Farm Site is Doneraile Park, located ca. 13km to the south west, which has limited views of the proposed development. The proposed turbines will be visible from the Ballyhoura Mountains to the east of the wind farm site and will be viewed along with other adjacent wind farms. Therefore, the proposed development does not represent a brand new visual element to the landscape.

Overall, it is expected that the operational phase of the proposed development will have a non-significant neutral impact on recreation and tourism in the area due to the distance of the proposed turbines from significant features.

Decommissioning Phase

The potential impacts associated with the decommissioning phase in relation to recreation, amenity and tourism will be similar to those associated with construction phase but will likely be of a reduced magnitude. The decommissioning works will not interact with nearby recreation and tourism amenities and therefore it is expected that the decommissioning phase of the proposed Annagh Wind Farm will have a non-significant impact on recreation, amenity and tourism.

11.4.2 Mitigation Measures – Recreation, Amenity and Tourism

Mitigation measures for recreation, amenity and tourism are primarily related to the preliminary design stage of the proposed Annagh Wind Farm, which has allowed for the prevention of unnecessary or inappropriate development to occur that would significantly affect any recreational or tourist amenity. Mitigation measures for potential effects associated with increased traffic volumes of the construction and decommissioning phases of the proposed development which may have an indirect impact on recreation and amenity in the area of the wind farm site.

11.5 Human Health & Safety

From analysis of the health statistics provided by the Central Statistics Office, the general health of the Study Area is recorded as very good or good. This is in line with State and County-wide averages. The Study Area has approximately the same averages, as County Cork with 88% of respondents of the 2016 Census indicating that their health was 'good' or 'very good' and between 1% and 2% indicating their health was 'bad'. Less than 0.5% of respondents indicated their health was 'very bad' for these areas. Overall, the Census data indicates that the population of the Study Area is generally in good health.

11.5.1 Potential Impacts

Construction Phase

The construction phase of the proposed development has potential to create health and safety hazards for both construction workers and the general public. This is as a result of construction activities and the associated impacts including increased traffic, transport of heavy or bulky materials, noise emissions, dust emissions, construction activities on public roads, excavation and general site-safety.

Aspects of the construction works that may present health and safety issues, are as follows:

- General construction site safety (e.g., slip/trip, moving vehicles etc.);
- Lifting of heavy loads overhead using cranes;
- Working at heights;
- Working in confined spaces;
- Ground conditions and soil stability;
- Road safety due to increased traffic numbers and transport of oversized loads to the site along turbine delivery routes and proposed haul routes;
- Pedestrian safety;
- Installation of electrical cables on-site and in the public road corridor;
- Potential emissions impacting air quality and noise;
- Substation construction involving high voltage electricity;
- Working with electricity during commissioning.

The works proposed as part of the proposed Annagh Wind Farm will pose a risk to construction workers on-site especially during adverse weather conditions. Construction and accommodating works taking place on the public road and the delivery of heavy/bulky goods and machinery on narrow roads may lead to temporary limited access to farmlands, forestry lands and residential properties creating a potential hazard. This may cause a potential temporary moderate, negative impact to public safety along the Turbine Delivery Route and grid route during the construction phase.

Potential impacts on air quality has the potential to affect human health. This has been assessed in Chapter 6: Air and Climate Change. No significant impacts on air quality have been identified with regard to the emissions of construction related traffic. The impact on air quality due to emissions from construction works (construction machinery) has been identified as imperceptible.

Construction works associated with the grid connection have potential to impact on nearby dwellings with regard to air quality. Due to the nature of construction along the proposed grid route, which works as a "rolling" construction site, meaning that these works will not be concentrated in any one area of the route, these effects are considered to be brief to temporary slight, negative

Potential impacts on human health associated with land, soils and geology during the construction phase relate to potential contamination of ground water which can be caused by hydrocarbon spills, siltation and landslide. Furthermore, landslides have the potential to cause injury and fatality. The wind farm site is within an area of 'Low' susceptibility to slope failure. Following implementation of mitigation the risk of slope failure at the wind farm site is considered negligible.

Potential impacts on human health associated with hydrology during the construction period relate to standing water caused by blocked drains, water collecting in excavated areas or diverted water resting in an undrained area. This has potential to cause drowning with particular risk to on-site staff. There is also potential for blockage of roadside drains causing potential hazard to traffic. A flood risk assessment has been carried out and a drainage design has been incorporated into the proposed development. As a result, the proposed development is expected to have a non-significant impact on flood risk in the surrounding area of the wind farm site or along the Grid Connection Route and Turbine Delivery Route.

At the time of preparation of this chapter, the COVID-19 virus represents a significant risk to human health. Similar to any construction site, potential for spread of the virus during the construction phase of the proposed development may occur due to potential transmission from worker to worker due to construction activities and potential for close quarter working conditions. Up to date HSE guidance will be consulted regularly in line with HSA recommendations and all reasonable on-site and travel precautions will be taken if COVID-19 remains a significant health issue during the construction phase.

Overall, if unmitigated, the construction phase of the proposed development has potential for temporary significant, negative impact to human health and safety for construction workers and members of the public in proximity to the site, if proper construction safety protocols and traffic management are not applied. Mitigation measures to prevent potential impact to human health and safety. Once mitigation is put in place, impacts to human health and safety during the 12-18 month construction period are unlikely.

Operational Phase

During the operation phase of the proposed development, there is potential for impact to human health and safety if appropriate mitigation measures are not put in place.

Potential human safety issues can occur due to the falling ice as a result of the icing of turbine blades in cold weather conditions. This is unlikely to present safety problems as wind turbines are fitted with anti-vibration sensors. These sensors detect any imbalance caused by the icing of the blades. The sensors will cause the turbine to shut down until the blades are de-iced prior to beginning operation again.

Potential impacts to the safety of operation and maintenance staff are associated with working at heights, working at steep gradients or uneven ground, moving vehicles and machinery and working with high-voltage electricity. Properly qualified staff will be employed at the wind farm site and safety protocol will be followed at all times. Therefore, impact to the safety of operation and maintenance staff is unlikely.

Under normal conditions, operational wind turbines do not pose a threat to public safety or the safety of animals.

There are no expected works to take place along the grid route or Turbine Delivery Route during the operational phase of the proposed development. If maintenance works are required in these areas or bulk equipment is required to be delivered, proper safety protocols will be put in place in line with the mitigation measures.

Therefore, impact to human safety on public roads during the operation phase is unlikely, as a result of the proposed development.

In terms of noise, operational wind farm noise levels meet the derived night and daytime noise limits at all residential properties surrounding the proposed Annagh Wind Farm. In relation to infrasound, based on information from the World Health Organisation, 'there is no reliable evidence that infrasound below the hearing threshold produce physiological or psychological effects' and that 'it may therefore be concluded that infrasound associated with modern wind turbines is not a source which may be injurious to the health of a wind farm neighbour'.

Based on the details of the proposed development, there will be no impact on residential properties at any distance from the proposed development in terms of magnetic field levels from power cables.

Following a review of literature regarding the potential impact of operational wind farms on human health, it is concluded that there is no scientific consensus to support an association between negative health impacts and responsible wind turbine development. The operational phase will therefore likely have a long-term, imperceptible, neutral impact on human health in proximity to the wind farm site.

The proposed development has been examined with respect to potential impact from major accidents and natural disasters. This relates to:

- Flooding;
- Fire;
- Major incidents involving dangerous substances;
- Catastrophic events; and
- Landslides.

There is limited potential for significant natural disasters to occur at the Annagh Wind Farm. Bulk storage of hydrocarbons, chemicals and wastes will not occur on the wind farm site. Emergency protocols will be in place should an accident occur at the proposed wind farm.

Decommissioning Phase

The potential impacts associated with decommissioning phase in relation to human health will be similar to those associated with construction phase. During the decommissioning works there is potential for significant impact to human health and safety for construction workers on site. Potential impacts to human health and safety on-site will be prevented through best practice methods as per the construction environmental management plan and will include staff training and knowledge of the site-specific decommissioning plan.

Once mitigation measures and best practice construction site methods are followed, potential negative impact on human health and safety is expected to be imperceptible and temporary.

During the decommissioning works there is potential for negative impact on health and safety of the public. These potential impacts are associated with the presence of a construction crew, increased traffic, presence of heavy goods vehicles and machinery and potential obstructions on the public road. Potential impact to public health and safety during the decommissioning phase is considered temporary moderate and negative. However, a Construction and Environmental Management Plan for decommissioning works will be followed, clear signage will be utilized on public roads and walkways and the community will be informed of works prior to commencement to avoid any potential negative impact to public health and safety. Once good practice is followed, the potential for negative impact on public health and safety is expected to be temporary and not significant.

11.5.2 Mitigation Measures _ Human Health & Safety

Construction Phase

To maintain safety and avoid health impacts on construction workers and the general public, best practice site safety and environmental management will be maintained. The proposed development will be designed, constructed, operated and decommissioned in accordance with the following:

- Safety, Health & Welfare at Work (Construction) Regulations 2013
- Safety, Health & Welfare at Work Act 2005
- Safety, Health & Welfare at Work (General Applications) Regulations 2007

All construction staff will be trained to the correct Health and Safety standards in order to carry out their duties and will be informed and aware of potential hazards. A Construction and Environmental Management Plan will be circulated to all construction workers which will detail safety protocol and methodology. Furthermore, site investigation has been completed and mitigation has been proposed, with all hazards 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.

FÁS Safe Pass 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 & Health Management Plan.

In relation to COVID-19, up to date HSE guidance will be consulted regularly in line with HSA recommendations and all reasonable on-site precautions will be taken to reduce the spread of COVID-19 on construction sites, should the virus be prevalent at the time of construction.

Once mitigation measures and health and safety measures are followed, the potential for impact on human health on the construction site during construction and decommissioning is expected to be not significant and temporary to short-term.

Appropriate warning signage will be posted at the construction site entrance, directing all visitors to the site manager. Appropriate signage will be provided on public roads approaching site entrances and a long haul routes to maintain public safety.

In relation to the Turbine Delivery Route, extra safety measures will be employed when large loads are being transported, for instance, Garda escort will be requested for turbine delivery and a comprehensive turbine delivery plan will be utilised to avoid potential impact to human safety for road users and pedestrians.

For the installation of the grid connection cable in the public road, a detailed traffic management plan will be developed in discussion with locals who will be directly impacted by the works, and in agreement with the Local Authority. Public consultation will be conducted along the grid cable route to inform local residents ahead of construction works.

Once mitigation measures and health and safety measures are implemented and followed, the potential for impact on human health for members of the public during construction and decommissioning of the proposed project is expected to be not significant and temporary to short-term.

Operation and Maintenance Phase

For operation and maintenance staff working at the proposed wind farm, appropriate site safety measures will be utilised during the operational phase by all permitted employees. All personnel undertaking works in or around the turbines will be fully trained and will use appropriate Personal Protective Equipment (PPE) to prevent injury.

Equipment within high voltage substations presents a potential hazard to health and safety. The proposed substation will be enclosed by palisade fencing and equipped with intruder and fire alarms in line with ESB and EirGrid standards.

All electrical elements of the proposed development are designed to ensure compliance with EMF standards for human safety.

All on-site electrical connections are carried by underground cable and will be marked out above ground where they extend beyond the track or hardstanding surface. Details of cables installed in the public road will be available from ESBN.

Lightning conductors will be installed on each turbine as all structures standing tall in the sky require this protection. Turbines specifically require this to prevent power surges to electrical components.

Turbines will be fitted with ice detection systems which will stop the turbine from rotating if ice is forming on a turbine blade. This aims to prevent ice throw which can cause injury.

Rigorous statutory and engineering safety checks imposed on the turbines during design, construction, commissioning and operation will ensure the risk posed to humans is negligible. 24-hour remote monitoring and fault notifications are included as standard in the Turbine Operations and Maintenance Contracts. In addition to scheduled maintenance, the maintenance contracts will allow for call out of local engineers to resolve any issues as soon as they are picked up on the remote monitoring system.

Access to the turbines inner structure will be locked at all times and only accessed by licenced employees for maintenance.

The design of the proposed wind farm has considered the susceptibility to natural disasters. The proposed site drainage will mitigate against any potential flooding risk with the use of swales.

A nominated competent person shall carry out checks and routine maintenance work to ensure the reliability and safe operation of fire-fighting equipment and installed systems such as fire alarms and emergency lighting. A record of the work carried out on such equipment and systems will be kept on site at all times.

Shadow flicker detection systems will be installed on all turbines in order to reduce potential occurrence of shadow flicker on nearby receptors.

In order to ensure the proposed wind farm is compliant with the noise limits, some of the turbines may need to be operated in noise reduced modes of operation in order to protect residential amenity.

The wind farm system shall include a kill switch that can be operated at any time with an overriding manual shutdown system in case of an emergency.

11.6 Material Assets - Renewable, Non-Renewable Resources and Utility Infrastructure

A number of active and historic quarries and mineral occurrences are located within 20km of the Wind Farm Site, as detailed in the GSI Online Minerals Database accessed via the Public Data Viewer. These consist of aggregates for concrete, hardcore, earthworks/fill, sandstone and shale quarries and recorded mineral occurrences, none of which are located within the wind farm site boundary.

Renewable resources at the site include plantations of commercial broadleaf forestry which is subject to an ongoing maintenance, felling and replanting schedule. Wind resource is average at the site.

A consented solar farm (Charleville Solar) is located to the north of the proposed Annagh Wind Farm.

No significant renewable and non-renewable resources have been identified along the Grid Connection Route or in proximity to Turbine Delivery Route node upgrades.

No significant renewable and non-renewable resources have been identified along the Grid Connection Route or in proximity to Turbine Delivery Route node upgrades.

11.6.1 Potential Impacts

Construction Phase

The construction of the proposed Annagh Wind Farm will impact on natural resources such as aggregates which will be sourced from batching plants, quarries and pits in proximity to the site.

The proposed development is intended to capture the renewable wind resource at the site. There will be no negative effects on the renewable wind resource of the receiving environment. Trees felled for development purposes will be replanted at another unplanted location as required by Irish Forest Service Guidelines. The overall effect of the proposed development on renewable timber resources at a national scale will be neutral.

The temporary removal of overhead utility infrastructure has the potential to cause a brief to temporary non-significant negative impact on nearby dwellings and commercial/industrial activities in proximity to Turbine Delivery Route nodes. Turbine delivery could potentially cause traffic disturbance and damage to road infrastructure if not properly planned and assessed.

The construction stage of the proposed development is not expected to impact on the adjacent consented Charleville Solar Farm development located in the townland of Fiddane. The buildability of the Charleville Solar Farm will not be negatively affected by the proposed Annagh Wind Farm as the proposed Annagh Wind Farm is completely separate to the consented solar farm. Each development has its own site entrance and they do not share any fields or areas. Although the proposed wind farm and consented solar farm share the same grid route, running along the L1322 local road leading to the Charleville 110kV substation, both can be accommodated in the public road as it has adequate width throughout.

It is unlikely that the proposed GCR will impact on the existing electrical infrastructure entering the existing Charleville substation.

During the construction phase of the proposed development, waste will be generated due to the various construction activities and materials required for the installation of infrastructure at the wind farm site, grid route and turbine delivery route. In line with the National Waste Management Guidelines for the circular economy and European Waste Management Hierarchy, the developer and appointed contractor will aim to prevent, reduce, reuse and recover as much of the waste generated on site as practicable and to ensure the appropriate transport and disposal of residual waste off site.

Operational Phase

Once the Annagh Wind Farm is operational, the potential for negative effects on material assets is minimal. Maintenance of access tracks and infrastructure may require small amounts of imported fill, however, the impact of this is likely to be slight/imperceptible.

The direct effect of electricity generated by the proposed development will give rise to a reduction in the quantity of fossil fuels required for electricity generation across the State. This will give rise to a long-term slight positive impact on renewable energy resource and will contribute to reducing Ireland's dependency on imported fuel resources.

Significant volume of waste is not expected to be produced during the operation phase of the proposed development.

The operation phase of the proposed Annagh Wind Farm has potential to impact on the consented Charleville Solar Farm, located directly to the north of the Wind Farm Site in the townland of Fiddane. This is as a result of potential loss of sunlight due to overshadowing of the consented solar arrays. The proposed wind farm includes redesigned elements to create a greater setback from the solar arrays. A production analysis and shading assessment was carried out to determine the potential impact on the consented solar farm. This analysis determined that the proposed Annagh Wind Farm will result in losses of 0.29% of total gross annual electricity production. This is considered to be a non-significant impact on the electricity production.

Decommissioning Phase

Decommissioning works will include removal of above ground structures including the turbines and met masts. Turbine foundations and access tracks will be left in situ. The proposed on-site substation building will be taken in charge of by ESB which will have a long-term slight positive impact on electricity infrastructure provision in the area. There will be no significant negative impacts on renewable and non-renewable resources during the decommissioning phase. No likely negative impacts on utility infrastructure are expected during the decommissioning phase.

Waste produced during the decommissioning phase will likely have a slight negative impact on the capacity of the licenced waste facilities used at the time of decommissioning.

11.6.2 Mitigation Measures – Renewable, Non-Renewable Resources and Utility Infrastructure

Existing services along the proposed grid connection cable route have been predicted through a desktop study and will be confirmed in the pre-construction surveys prior to construction. This will minimise the impact in terms of disruption or damage to existing utilities. It is not intended to divert existing services but instead, where possible, the cable will be laid above or below existing services. Communication with service providers will be maintained for the duration of the construction works where required.

Non-renewable resources of stone and fill will be sourced locally insofar as possible to minimise transportation distances.

The 12.6 hectares of commercial forestry which will be felled at the proposed Annagh Wind Farm site will be replanted at alternative lands under a felling licence.

Where services and street furniture are required to be removed temporarily to accommodate turbine delivery, residents and business in proximity to the works will be informed in advance.

12. SHADOW FLICKER

Under certain combinations of geographical position, wind direction, weather conditions, times of day and time of the year, the sun may pass behind the rotors of a wind turbine and cast a shadow over the windows of nearby buildings. When the blades rotate and the shadow passes a window, to a person within that room the shadow appears to 'flick' on and off; this effect is known as 'shadow flicker'.

A study area of 1,500 m from each of the 6 wind turbines was selected for this assessment. This is based upon ten times the maximum rotor diameter (150 m) that would be used within the proposed development. There are a total 75 receptors identified within the 1,500 m shadow flicker study area. There are two wind farms located in proximity to Annagh Wind Farm; Boolard Wind farm and Rathnacally Wind Farm, which have been examined for potential cumulative shadow flicker effects.

12.1 Potential Impacts

Construction Phase

Shadow flicker can only occur as a by-product of wind turbine operation; as such, there will be no shadow flicker effects during the construction phase.

Operational Phase

The shadow flicker model calculated all possible instances of shadow flicker that may occur throughout the year, based on the sun's path across the sky relative to the turbine and receptor locations. There is the potential for shadow flicker to occur at 52 of the 75 receptors considered within the overall study area. At the remaining 23 receptors the suns angle relative to the turbines and receptors never reaches the required position for shadow flicker effects to occur.

The shadow flicker model does not account for weather conditions, which have a significant impact upon the amount of shadow flicker that may actually occur. In order to consider a more realistic scenario, annual average sunshine hours for the region have been taken into account. The predicted 'likely' levels of shadow flicker are above the Wind Energy Development Guidelines (2006) threshold of 30 hours per year at 4 receptors and mitigation measures would need to be adopted to limit the number of days that shadow flicker occurs for these receptors.

The predicted *maximum* theoretical hours per day of shadow flicker exceeds 30 minutes at 43 receptors (based on worst case) within the overall study area. The *average* theoretical hours per day exceeds 30 minutes at 14 receptors. Accordingly, mitigation measures would need to be adopted to limit the maximum amount of shadow flicker occurring on any one day.

No cumulative shadow flicker effects were identified at nearby receptors.

Decommissioning Phase

Shadow flicker can only occur as a by-product of wind turbine operation; as such, there will be no shadow flicker effects during the decommissioning phase.

12.2 Mitigation Measures

Shadow flicker control modules, consisting of light sensors and specialised software, will be installed on the turbines as part of a system to prevent operation during periods when shadow flicker may occur to attain 'zero shadow flicker'. The calculated potential shadow flicker periods will be input into the turbine control software and when the correct conditions are met i.e. the light intensity is sufficient and during a potential period of shadow flicker. When the threshold is exceeded, individual turbines will cease operation until the conditions for shadow flicker are no longer present. This method of mitigation will be used to fully mitigate all shadow flicker effects resulting in zero shadow flicker.

13. TRAFFIC AND TRANSPORT

The study area for the traffic and transportation study includes the main wind farm site along with the surrounding road network leading to and from the main wind farm site. The site entrance is also assessed. The roads associated with the grid connection are assessed as is the turbine delivery route.

Roads in the Republic of Ireland are classified as motorways, national (primary and secondary), regional and local roads. Transport Infrastructure Ireland (TII) has overall responsibility for the planning and supervision of the construction and maintenance of motorways, national primary and secondary roads. The local authorities have responsibility for all non-national roads.

5km to the east of the site, the closest national primary route is the N20 which connects the M20 at Limerick to Cork City. Approximately 30km of this road will be part of the turbine delivery route. The closest national secondary route to the south of the site is the N73. The N73 runs from the M8 motorway to Mallow and is located approx. 25km from the site boundary. Other national routes which will be used as part of the proposed project include the N69 and N18 in County Limerick which form part of the Turbine Delivery Route. There are several local roads in the vicinity of the proposed project. The proposed delivery route proposes the use of one of the local roads to the North of the site, the local road which connects the proposed site entrance to the N20 at Ballyhea (L-1322). The grid connection utilizes the L1322 road for approximately 3km before turning left (north) onto an unnamed local road for approximately 0.5km where it reaches the Charleville 110kv Substation.

13.1 Potential Impacts

13.1.1 Construction Phase

The construction activities associated with the project will lead to additional construction related traffic on the existing public road network over the duration of the construction works. These impacts will include:

- Heavy Goods Vehicles (HGVs) transporting materials to and from the site, including road making materials, concrete, building materials, drainage/ducting materials, cabling, electrical components and excavated material.
- HGVs transporting conventional earthworks machinery such as excavators, dumper trucks and rollers.
- Fuel trucks transporting fuel for plant to each site compound during the construction phase
- Light Goods Vehicles (LGVs) such as cars, 4x4s and vans used by the workers and supervisory staff involved in the construction works.
- Oversized loads including turbine components (more details below).

Without appropriate mitigation measures, the proposed works have the potential to lead to a negative impact on the existing road network including:

- Delay and disruption to road users;
- Road safety issues should the works not be carried out in line with good traffic management practices;
- Inappropriate parking of construction related vehicles along the route of the works;

- Soiling of the public road leading to a general lack of cleanliness and poor skid resistance on roads;
- Damage to existing road surface.

Grid Route

The traffic impact associated with the grid connection cable works will fall into two main categories, the construction traffic related impacts and the road/lane closure related impacts. The use of heavy goods vehicles, light goods vehicles and the transport of materials will be involved with the grid connection. The grid connection construction works will require a combination of temporary road closures with traffic diversions and temporary lane closures along the proposed route.

All road works will be subject to a road opening licence, but it is anticipated that the cable installation along local roads will be advanced using a combination of rolling lane closures and temporary road closures where the existing road width is insufficient to accommodate an open lane for traffic to pass the works area.

Turbine Delivery Route

The delivery of turbine components including blades, tower sections and nacelles is a specialist transport operation owing to the oversized loads involved. The blades are the longest component and have been considered for the purpose of this assessment. Turbine component deliveries will be carried out during off-peak times and will be done using a convoy and a specialist heavy haulage company. Turbine deliveries will also be escorted by An Garda Siochána. Without appropriate mitigation measures, the construction of the proposed temporary accommodation works have the potential to lead to a negative impact on the existing road network including:

- Delay and disruption to road users;
- Road safety issues should the works not be carried out in line with good traffic management practices;
- Inappropriate parking of construction related vehicles in the public road in the vicinity of the works areas;
- Soiling of the public road leading to a general lack of cleanliness and poor skid resistance on roads;
- Damage to existing public road infrastructure.

13.1.2 Operational Phase

A small number of full-time wind farm personnel are expected to be present during the operational phase of the project. Traffic associated with the operational phase of the project will be associated with the wind farm owner/operator and grid network operator personnel visiting the substation, and maintenance staff. There will also be a limited infrequent attendance by routine environmental monitoring/compliance staff.

Routine turbine maintenance is generally conducted by personnel climbing inside the tower. However, there may be circumstances where a crane may need to be mobilised to site to conduct non-routine maintenance.

The proposed substation has been designed in accordance with network operator requirements with welfare facilities however they will not require full time operational staff and shall be largely automated with occasional visits from maintenance teams.

Unforeseen or unplanned events such as emergency turbine repair works could potentially require the mobilisation of construction plant and personnel to site or grid route. The replacement of a large turbine component such as a blade will require a crane and the re-installation of some Turbine Delivery Route temporary accommodation works. In such an event the impacts associated with these works will be less than those associated with the construction stage.

13.1.3 Decommissioning Phase

On decommissioning, cranes will disassemble the above ground turbine components which will be removed off site for recycling. The foundations will be covered over and allowed to re-vegetate naturally if required. It is proposed that the internal site access tracks and hard standings will be left in place. Infrastructure associated with the grid connection will form part of the national transmission network and will be left in-situ. The traffic impact associated with the decommissioning phase will be significantly less than the construction phase due to the considerably lower number of vehicle movements.

13.2 Mitigation Measures

13.2.1 Construction Phase Mitigation Measures

A traffic management plan will be agreed with the road's authority and An Garda Siochána prior to commencing construction. This includes the following:

- **Traffic Management Co-Ordinator** – A dedicated 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 on the project.
- **Roads and Routes**: The final TMP will clearly identify roads that will be used to access the project site and roads that are not to be used. In some cases, the roads authority may wish that certain roads are not used for HGVs but can be used by LGV traffic.
- **One-way Systems**: as some of the local roads are relatively narrow, the roads authority may want to introduce a system of one-way construction traffic movements during the construction of the development. Any such one-way systems will be identified in the construction stage TMP in agreement with the roads authority.
- **Road Closures**: with the use of the local roads network for the grid connection route, the narrow carriageway widths for some of the roads proposed may require full road closures. Any such road closures would be agreed with the roads authority in advance of construction and diversions would be incorporated into the traffic management plan.
- **Road Condition Survey**: a pre-condition survey will be carried out on all public roads that will be used in connection with the development to record the condition of the public roads in advance of construction commencing. A post-construction survey will also be carried out after the works are completed. The specification and timing of the surveys will be agreed with the roads authority. Joint surveys shall be completed if the roads authority requests.
- **Road Reinstatement**: All roads will be reinstated expeditiously on completion of the construction works. Roads will be reinstated to their pre-works condition or better and to the satisfaction of the roads authority.

- **Site Inductions**: All workers will receive a comprehensive site induction which will include a section on traffic management and clear guidance on the routes to be used/not used to access the site.
- **24-Hour Emergency Contact**: a 24-hour emergency phone number will be maintained for the duration of the construction works and the number will be noted on temporary signage at each works area (for grid connection) and the site entrance for the wind farm site.
- **Traffic Management Guidance**: all necessary temporary traffic management will be planned and executed in accordance with best practice, including Chapter 8 of the Traffic Signs Manual published by the Department of Transport.
- **Letter Drops**: a letter drop will be carried out to notify members of the public living near the proposed site and cable route to advise them of any particular upcoming traffic related matters e.g. temporary lane/road closure or delivery of turbine components.
- **Signage**: Clear signage relating to the development, both temporary and permanent, will be provided for accessing the site.
- **Road Sweeper**: Appropriate steps will be taken to prevent soil/dirt generated during the works from being transported on the public road. When, if necessary, a road sweeper will be used to maintain the public roads in a clean condition during the construction activities of the project.
- **Site Entrances**: The entrances to the site will be secured when the site is not in use. When necessary a flagman will be used to assist traffic movements at the site entrance or in other areas as required.
- **Abnormal Load Deliveries:** Abnormal loads will require an abnormal load permit prior to delivery and will be delivered at times and frequencies directed by An Garda Siochána.
- **Banksman:** During the construction phase a banksman will control traffic at the southern entrance to maintain traffic safety on the local road during construction activities relating to the installation of the proposed 100m met mast. The southern access will not be used for any other elements of the proposed development during the construction phase.

Mitigation measures for the proposed grid route include road opening licence, route proofing maintaining local access, maintaining road cleanliness, temporary trench reinstatement, use of a designated haul route, avoid overlap of turbine delivery and grid route works.

Mitigation measures for the turbine delivery includes production of a programme of deliveries, organisation of a garda escort, reinstatement of any accommodation works required and consultation with local residents.

Overall, there are no significant impacts expected on the receiving environment as a result of the construction, operation and decommissioning of the proposed project. The proposed project is likely to result in a slight to moderate short-term negative impact on the existing road network during the construction phase if adequate mitigation measures are not implemented.

13.2.2 Operational Phase Mitigation Measures

Site entrances at the wind farm site shall be maintained continually to ensure conditions at these entrances do not deteriorate. Hedgerow maintenance will be required to ensure continued visibility at the entrances.

13.2.3 Decommissioning Phase Mitigation Measures

The traffic impact associated with the decommissioning phase will be significantly less than the construction phase. All decommissioning works are to be carried out in accordance with a decommissioning plan to be prepared prior to the decommissioning phase of the project and agreed with the planning authority in advance. Traffic management measures identified will be included in the decommissioning plan for the wind farm.

Similar to the construction phase, a banksman will be required at the southern site entrance for the decommissioning (removal from site) of the proposed 100m met mast. Mitigation measures adopted for project decommissioning shall be in line with those identified for the construction phase of the proposed development.

14. ARCHAEOLOGY, ARCHITECTURAL AND CULTURAL HERITAGE

A study area extending for 1km in all directions from the proposed locations of turbines, hardstands, access tracks, site compound, met mast and substation and 100m in all directions from the grid connection route and turbine delivery work areas was reviewed in order to assess the potential for direct impacts on known and potential elements of the cultural heritage resource. In addition, the wider landscape extending for 10km from the Site was also reviewed to assess the potential for indirect impacts on the settings or visual attributes (e.g., ritual alignments or intervisibility) of monuments with notable visual sensitivities, e.g., National Monuments in State Care (Ownership / Guardianship) and other extant recorded monuments with potential ritual visual alignments across the landscape.

There are 23 recorded archaeological sites located within 1km of the locations of proposed construction areas within the Site and these range in date from the late prehistoric to post-medieval periods. There are no recorded archaeological sites, designated architectural heritage structures or Architectural Conservation Areas directly located on the public road that will form the grid route connection and which also forms the section of the turbine delivery route. There are six recorded archaeological sites located within 100m of the grid route.

14.1 Potential Impacts

14.1.1 Construction Phase

In relation to potential direct impacts on archaeology from the proposed development, there are no recorded archaeological sites located on the footprint of any of the proposed construction areas within the Site and no potential unrecorded archaeological sites were identified within these areas during the desktop study and field inspections carried out as part of this assessment. The nearest recorded archaeological site to proposed construction areas within the Site is a fulacht fia located c.75m to the west of the substation.

While no surface traces of potential unrecorded archaeological sites were noted in these areas the potential exists for the presence of subsurface archaeological sites, features or artefacts within such green field lands. As the existence, nature and extent of any unrecorded sub-surface archaeological remains within the study area are unknown; the level of potential impacts is indeterminable, but ground works during the construction phase will have the potential to result in permanent, direct, negative effects on any unrecorded archaeological sites that may exist within the footprint of the construction locations. The presence of extensive woodland plantations, including tree roots, at the locations of the majority of turbines and associated hardstands will preclude advance archaeological site investigations such as geophysical survey and test trenching at their locations.

Given the above factors, no direct impacts on the known archaeological resource are predicted during the construction phase.

14.1.2 Operational Phase

The operational phase of the proposed development will result in no predicted direct impacts on the known archaeological, architectural and cultural heritage resources.

The successful implementation of the construction phase mitigation measures outlined in Section 14.5 will result in the preservation *in situ* by avoidance, or the preservation in record by archaeological excavation, of any unrecorded, sub-surface archaeological sites or features that may exist within proposed development areas.

There are 23 recorded archaeological sites, including associated demesne lands of two country houses, located within 1km of the wind farm redline boundary. The majority of these archaeological sites are either completely or partially levelled and are all located within private lands which are not accessible to the public and have no discernible existing tourist or amenity attributes. None comprise monument types that have potential visual attributes associated with ritual practices such as alignments across the landscape towards astronomical events, e.g., stone circles, stone rows or megalithic tombs, that could be potentially impinged upon by wind turbines and there are no recorded examples of such prehistoric monuments within 10km of the proposed project.

No significant indirect visual impacts on cultural heritage receptors within the wider landscape were identified.

14.1.3 Decommissioning Phase

No direct impacts on known elements of the cultural heritage resource are predicted during the decommissioning phase as there are no recorded cultural heritage assets located within the footprint, or close environs, of the various elements of the wind farm that will be subject to decommissioning. The decommissioning phase will reverse the slight to non-significant indirect visual impacts on extant cultural heritage receptors located within surrounding lands as well as those within the wider landscape as identified in Chapter 15.

14.2 Mitigation Phase

The presence of extensive woodlands plantations, including tree roots, at the locations of the majority of turbines and associated hardstands will preclude advance archaeological site investigations such as geophysical survey and test trenching at their locations. A systematic advance programme of archaeological fieldwalking surveys will be undertaken within all construction areas within these woodlands following pre-construction tree felling to assess whether there are any surface traces of any potential unrecorded archaeological or architectural heritage sites exist within these areas. Archaeological monitoring of ground excavation works during the construction phase will then be carried out within all areas of the Site under licence by the National Monuments Service of the Department of Housing, Local Government and Heritage. In the event that any unrecorded, sub-surface archaeological sites or features are identified during these site investigations they will be recorded and cordoned off while the National Monuments Service are consulted to determine further appropriate mitigation measures, which may include preservation by avoidance or preservation by record through systematic archaeological excavations.

The locations of all recorded archaeological sites within the environs of construction areas will be cordoned off and the outer edges of their designated Zones of Notification will be clearly signed as 'No Entry: Archaeological Areas' for the duration of the construction phase. The locations of the two derelict, late 19th century farmyards within the environs of the Site will also be clearly marked as no entry areas. Their locations will be subject to inspections by the appointed archaeologist at regular intervals during monitoring of the construction phase to ensure that the protective measures are being successfully implemented.

The programme of archaeological supervision of the construction phase of the Development will also include monitoring ground excavation works and vegetation clearance within the section of the L1322 road in the environs of known archaeological sites.

In relation to the monitoring of mitigation measures, there are a number of obligatory processes to be undertaken as part of archaeological licence applications to the National Monuments Service and these will allow for monitoring of the successful implementation of the archaeological mitigation measures. These will clearly outline the extent of all ground works and outline the onsite and consultation processes to be enacted in the event that any unrecorded archaeological sites or features are identified. A report will be compiled on all site investigations which will clearly present the results in written, drawn and photographic formats and copies will be submitted to the National Monuments Service, the Planning Authority and the National Museum of Ireland.

In conclusion, the mitigation measures will provide for either the avoidance of the unrecorded archaeological resource or the proper and adequate recording of this resource by systematic archaeological excavation. While the operation of the proposed wind farm will result in a number of indirect, slight, negative impacts on a number of cultural heritage receptors within the wider landscape these will be reversible during the decommissioning phase. No residual impacts on the architectural heritage and undesignated cultural heritage resources are predicted to arise following decommissioning of the wind farm. No residual impacts on the cultural heritage resource are predicted to arise from the grid connection route or turbine delivery route.

15. LANDSCAPE AND VISUAL

The terrain within the study area is lowland and gently undulating, mostly keeping between 80m above sea level and 150m above sea level. The most apparent landform within the study area is that of the Ballyhoura Mountains, which runs east-west over a course of up to approx. 12km. The Ballyhoura foothills are 5-6km east of the site, with their rounded-profile summits cresting 7-8km distance from the site. The range peak at Seefin Mountain, at 528m above sea level, is approx. 9km east of the site. Within the central study area, land also tends to be undulating but of a broadly gentle, non-dramatic profile, ranging between 80m-170m above sea level. The turbines are proposed in a gently undulating area between 95m-100m above sea level.

The vast majority of land use within the ever-evolving, highly anthropocentric study area is that of agricultural farmland, bound by a network of mixed hedgerow vegetation, and with very few fallow or under-utilised land. Being within the Golden Vale (i.e. the best land in Ireland for dairy farming), pasture is more prevalent than tillage. Fields tend to medium-sized, with smaller fields over approx. 250m-200m and larger fields on the flatter basins. However, pockets of commercial forestry can also be found scattered through the study area, particularly on upland or marginal terrain.

15.1 Proposed Development

A computer generated Zone of Theoretical Visibility (ZTV) map has been prepared to illustrate where the proposed turbines are potentially visible from. The ZTV map is based solely on terrain data (bare ground visibility), and ignores features such as trees, hedges or buildings, which may screen views. The ZTV map is presented in Figure 15-1. Here we can see the areas within 20km of the proposed turbines where 5 to 6 turbines will be visible (blue areas), 3 to 4 turbines will be visible (orange colour) and 1 to 2 turbines will be visible (yellow colour). The bare ordinance survey mapping indicates areas where the proposed turbines will not be seen.

Photomontages of the proposed wind farm have been prepared. These are photographs taken from various locations in the vicinity of the proposed development with a computer generated model of the proposed wind farm included. This is used to study the landscape and visual impact of the proposed wind farm in detail. 19 different viewpoints have been selected. These photomontages are included in Volume 4 of the EIAR.

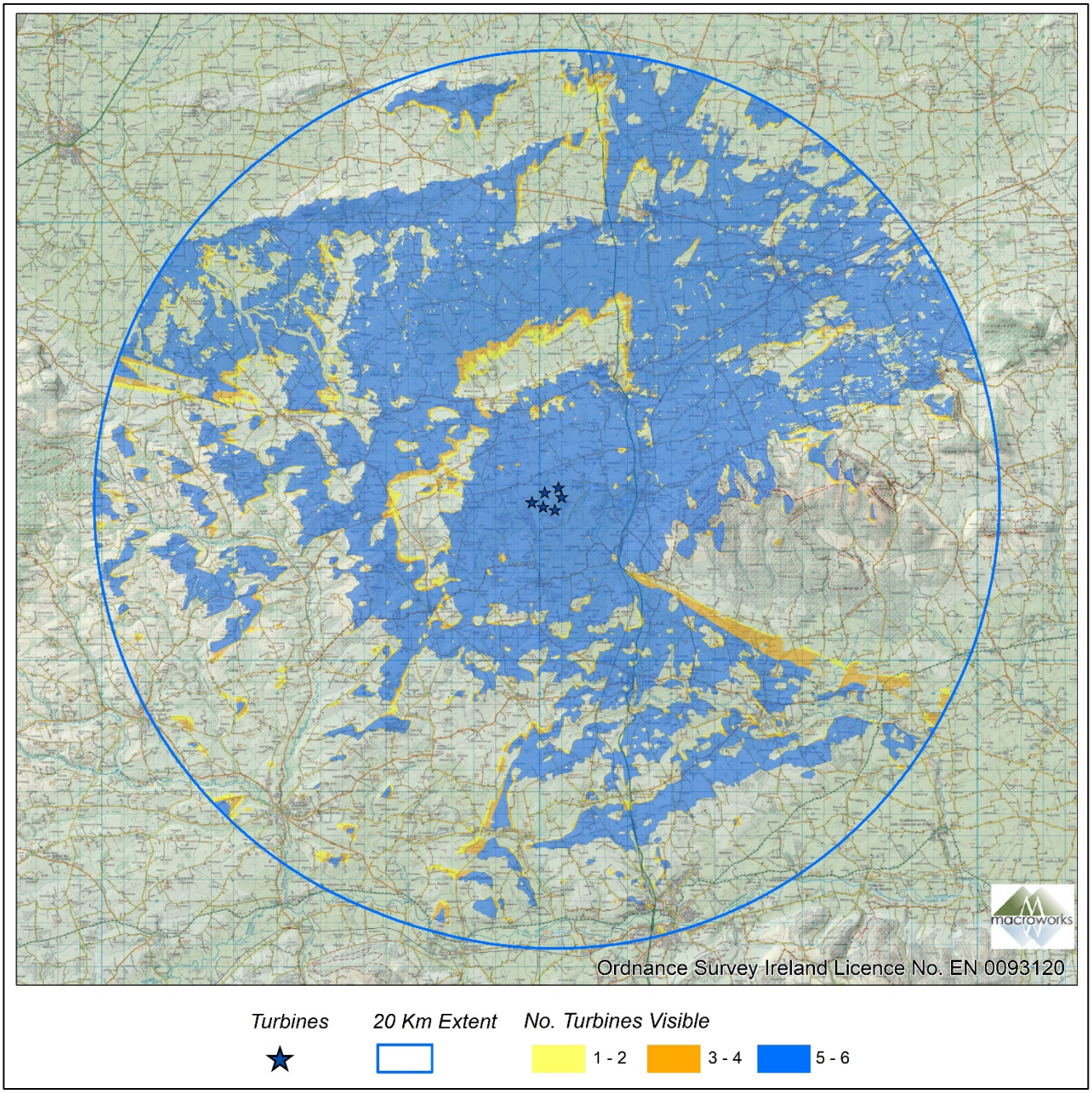

Figure 15-1: Zone of Theoretical Visibility Map

15.2 Mitigation Measures

Given the highly visible nature of commercial wind energy developments it is not generally feasible to screen them from view using on-site measures, as would be the primary form of mitigation for many other types of development. Instead, landscape and visual mitigation for wind farms must be incorporated into the early stage site selection and design phases.

In this instance, the two main forms of landscape and visual mitigation employed were:

- Mitigation by avoidance and design
- Buffering of Residential Receptors

One of the main mitigation measures brought forward from these early-stage studies during the development of the project was that the layout would avoid the River Blackwater Special Area of Conservation, which enters the most south-western section of the site: the identification of this constraint resulted in a more than 600m distance being established between it and the location of the nearest proposed turbine. Design optimisation analysis of the initial turbine layout for the proposed development was then carried out and the proposed layout was refined and improved to reduce potential and/or likely visual impacts associated with the proposed development. A setback distance of 700m was applied between nearby dwellings and the proposed turbines. This has been achieved at all but one dwellings which is an involved landowner's dwelling, located 690m from the nearest proposed turbine.

15.3 Potential Impacts

15.3.1 Construction Phase Impacts

Site activity will be at its greatest during the construction phase due to the operation of machinery on site and movement of heavy vehicles to and from site. This phase will have a more significant impact on the character of the site than the operational phase, but it is a 'short-term' impact that will cease as soon as the proposed development is constructed and becomes operational (approximately 12-18 months from the commencement of construction).

There will be some long term/permanent construction stage effects on the physical landscape in the form of turbine foundations and hardstands, access tracks and a substation, but only the on-site substation is likely to remain in perpetuity as part of the national grid network. It is likely that, with the exception of some residually useful access tracks, all other development features will be removed from the project site and it will be reinstated to agricultural or forestry use upon decommissioning. Thus, the construction stage landscape effects of the proposed development are largely reversible.

There will be some construction stage effects on landscape character generated by the intensity of construction activities (workers and heavy machinery), as well as areas of bare-ground and stockpiling of materials as identified in the Construction and Environmental Management Plan (CEMP). Such effects will be temporary/short term in duration and are, therefore, not considered to be significant.

15.3.2 Operation Phase Impacts

In the case of this proposed development, wind turbines are a characteristic feature of the central and wider study area, most notably to the northeast and northwest of the site. Two existing wind farms (Rathnacaly and Boolard) are within the central study area, each consisting of two turbines, located within 2.5km of the site. Further wind farms are found in the wider study area, most patently the Ballyhoura Mountains. In that location, less than 10km from the site, the existing Buttevant (Knockatalig) and Castlepook Wind Farms are highly evident across the surrounding lowlands, hosting 20 turbines between them. The effect, therefore, is one of intensification and extension of an established land use in this landscape and not the introduction of a new and unfamiliar feature.

This development proposal represents a long term, but not permanent impact on the landscape and is reversible. The lifespan of the project is 35 years, after which time it will be dismantled and the landscape reinstated to prevailing conditions. Within 2-3 years of decommissioning, it is likely that there will be little evidence a wind farm ever existed on the site, albeit the proposed on-site substation will remain in perpetuity as part of the national grid infrastructure, in addition to some residually useful access tracks.

The significance of residual landscape impact of the proposed development is considered to be **Moderate-slight** throughout the Central Study Area. For the wider study area (beyond 5km from the site), residual landscape impact significance is not considered to exceed **Slight** and will reduce to Imperceptible at increasing distances as the project becomes a progressively smaller component of the wider landscape fabric.

15.4 Decommissioning Phase

The decommissioning phase will have similar temporary impacts as the construction phase with the movement of large turbine components away from the site. This may potentially result in the minor loss of roadside and trackside vegetation that has grown during the operation phase of the project, but this can be reinstated upon completion of decommissioning. Areas of hard standing that are of no further use will be reinstated and reseeded to blend with the prevailing surrounding land cover of the time. It is expected that the decommissioning phase would be completed within a period of approximately 6 months.

16. TELECOMMUNICATIONS AND AVIATION

The proposed development has been examined for the potential impact on telecommunications and aviation. This was completed through consultation with telecommunications providers and airport and aviation authorities. Telecommunication providers were asked to identify their infrastructure and links in the area in order to identify potential impacts to their services from the proposed wind turbines. Similarly, the airport and aviation authorities were asked to identify potential impact from the proposed turbines on infrastructure and airfields.

16.1 Potential Impacts

In the context of wind farm development, electromagnetic interference is the impact of a wind farm on existing telecommunication services resulting in an unacceptable negative impact. The rotating blades of a wind turbine can occasionally cause interference to electro-magnetically-propagated signals. Such interference could, in theory, affect all forms of electromagnetic communications including:

- Satellite communications
- RADAR
- Cellular radio communications
- Aircraft instrument landing systems
- Air traffic control
- Terrestrial telecommunication links
- Television broadcasts

For the purposes of the telecommunications impact assessment, point-to-point and point-to-multipoint signals are considered, both are used extensively throughout Ireland. Point to point (or line of sight) is a wireless telecommunications transmission link between two nodes located at specified fixed points.

The term telecommunications link relates to the wireless transmission of data via radio frequencies between two fixed points. Telecommunications towers are generally used to transmit and receive signals over large distances. Radio frequency bands above 1 GHz are referred to as microwave radio links and are commonly used by telecommunications operators.

The proposed turbines have potential to interfere with these links if positioned in between their points.

16.1.1 Construction Phase

The potential for electromagnetic interference from wind turbines occurs only during the operational phase of the project. There are no electromagnetic interference impacts associated with the construction phase of the proposed project on telecommunications and broadcasting in the area.

As the proposed grid connection will be constructed underground in the public roadway, there are no construction related impacts for electromagnetic interference and broadcasting interests in the area.

There is potential for aviation impacts during the late construction phase of a wind farm project and prior to the commissioning of the proposed project as the wind turbines are constructed and placed in situ. The turbines could be considered to be an obstacle to low flying craft.

The closest airport to the proposed wind farm is Shannon Airport, c. 43km north west. Rathcoole Aerodrome is located c. 29km south west. Cork Airport is located c. 52 km south of the Annagh Wind Farm Site. Noting the presence of existing/consented nearby turbines to the proposed wind farm and the distances to existing airports, it is considered therefore that there will be no significant effect on aviation from the proposed project during the construction phase.

As the proposed grid connection will be constructed underground within the public roadway, there are no construction related impacts on aviation interests associated with the Grid Connection Route.

16.1.2 Operation Phase

During the operation phase, it is not expected that the proposed grid connection will have any operational related impacts on telecommunications and broadcasting interests in the area.

There is not expected to be any temporary impact to overhead lines during the operational phase of the proposed development. In the unlikely event that a turbine requires repair or replacement, a brief to temporary impact to overhead lines will occur during the delivery of turbine components.

The potential for aviation impacts during the operational phase of the project are similar to those as set out in the construction impact section. Noting Irish Aviation Authority's response to the scoping request, the response received from Shannon Airport and Dublin Airport Authority, the presence of existing adjacent turbines to the proposed wind farm and the distances to existing airports, it is considered therefore that there will be no significant effect on aviation from the proposed project during the operational phase.

As the proposed grid connection will be operating underground within the public roadway, there are no operational related impacts on aviation interests as a result of the operation of the Grid Connection Route.

16.1.3 Decommissioning Phase

The potential for electromagnetic interference from wind turbines occurs only during the operational phase of the project. There are no electromagnetic interference impacts associated with the construction or decommissioning phases of the proposed project, and therefore no mitigation required.

The proposed grid connection will be left in situ underground within the public roadway. There are no decommissioning related impacts on telecommunications and broadcasting interests in the area.

If overhead lines have to be temporarily disconnected at the time of decommissioning, the impacts will be no greater than those assessed at construction stage.

During the decommissioning phase, the turbines will be dismantled and removed from the site, thereby removing all potential obstacles to aviation interests. There will be no significant effects on aviation.

The proposed grid connection will be left in situ underground within the public roadway. There are no decommissioning related impacts on aviation associated with the Grid Connection Route.

16.2 Mitigation Measures

The proposed grid connection will be left in situ underground within the public roadway and will not cause any interference to telecommunications or broadcasting. As a result, there are no mitigation measures proposed for the Grid Connection Route.

In advance of the main grid connection works the precise alignment of the cable route within the corridor will be defined. This will include slit trenching which will ensure the avoidance of existing services in the road. Overhead telecommunication lines will be temporarily disconnected and then reconnected following turbine delivery to the site. No mitigation measures are required.

In relation to Aviation, no mitigation measures are required.

17. INTERACTIONS OF THE FOREGOING

This Chapter considers the potential for interactions and inter-relationships between one aspect of the environment and another which can result in an impact being either positive or negative, as well as having varying significance. The chapter considers potential significant environmental effects that may occur in terms of the interaction and inter-relationships of Air Quality & Climate, Noise & Vibration, Biodiversity, Land, Soils & Geology, Hydrology & Water Quality, Population & Human Health, Material Assets, Shadow Flicker, Traffic & Transportation, Archaeology, Architectural & Cultural heritage, Landscape & Visual and Telecommunications & Aviation, as a result of the proposed project as described in Chapter 3.

Table 17-1 herein provides a matrix detailing the key interactions and inter-relationships between the key environmental aspects of the proposed project, including the wind farm, grid connection route and turbine delivery route.

Each individual chapter of the EIAR has had regard to interactions between different potential impacts. For example, Hydrology & Water Quality has had regard to potential impacts on Biodiversity; and Land, Soils and Geology has had regard to potential impacts on both Biodiversity , Hydrology & Water Quality and Traffic & Transportation.

Table 17-1: Matrix of Interaction Between key Environmental Aspects

	Air Quality & Climate	Noise & Vibration	Biodiversity	Land, Soils & Geology	Hydrology & Water Quality	Population, Human Health & Material Assets	Shadow Flicker	Traffic & Transport	Archaeological, Architectural & Cultural Heritage	Landscape & Visual	Telecommunications & Aviation
Air Quality & Climate		■	■	■		■		■			
Noise & Vibration	■		■	■		■	■	■		■	
Biodiversity	■	■		■	■	■		■			
Land, Soils & Geology	■	■	■		■	■		■	■		
Hydrology & Water Quality			■	■		■		■	■		
Population, Human Health & Material Assets	■	■	■	■	■		■	■	■	■	
Shadow Flicker		■				■				■	
Traffic & Transport	■	■	■	■	■	■					
Archaeological, Architectural & Cultural Heritage				■	■	■				■	
Landscape & Visual		■				■	■		■		
Telecommunications & Aviation											

■ = interaction or inter-relationship □ = no interaction or inter-relationship

FEHILY TIMONEY

CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE & PLANNING

www.fehilytimoney.ie

CORK OFFICE
Core House
Pouladuff Road,
Cork, T12 D773,
Ireland
+353 21 496 4133

Dublin Office
J5 Plaza,
North Park Business Park,
North Road, Dublin 11, D11 PXT0,
Ireland
+353 1 658 3500

Carlow Office
Unit 6, Bagenalstown Industrial
Park, Royal Oak Road,
Muine Bheag,
Co. Carlow, R21 XW81,
Ireland
+353 59 972 3800