CNOC RAITHNÍ (KNOCKRANNY) WIND FARM

VOLUME II EIAR

Environmental Impact Assessment Report

CNOC RAITHNÍ (KNOCKRANNY)
WIND FARM

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1. INTRODUCTION

1.1. Background

This Environmental Impact Assessment Report (EIAR) has been prepared on behalf of Western Power Developments Limited to consider the likely significant environmental effects of a proposed development comprising amendments to the permitted Cnoc Raithní (Knockranny) Wind Farm (as permitted under Galway County Council Reference 13/829 / An Bord Pleanala Reference PL07.243094), provision of underground cabling, and grid connection infrastructure at Ardderroo Substation[1] to allow the project to be connected to the national grid.

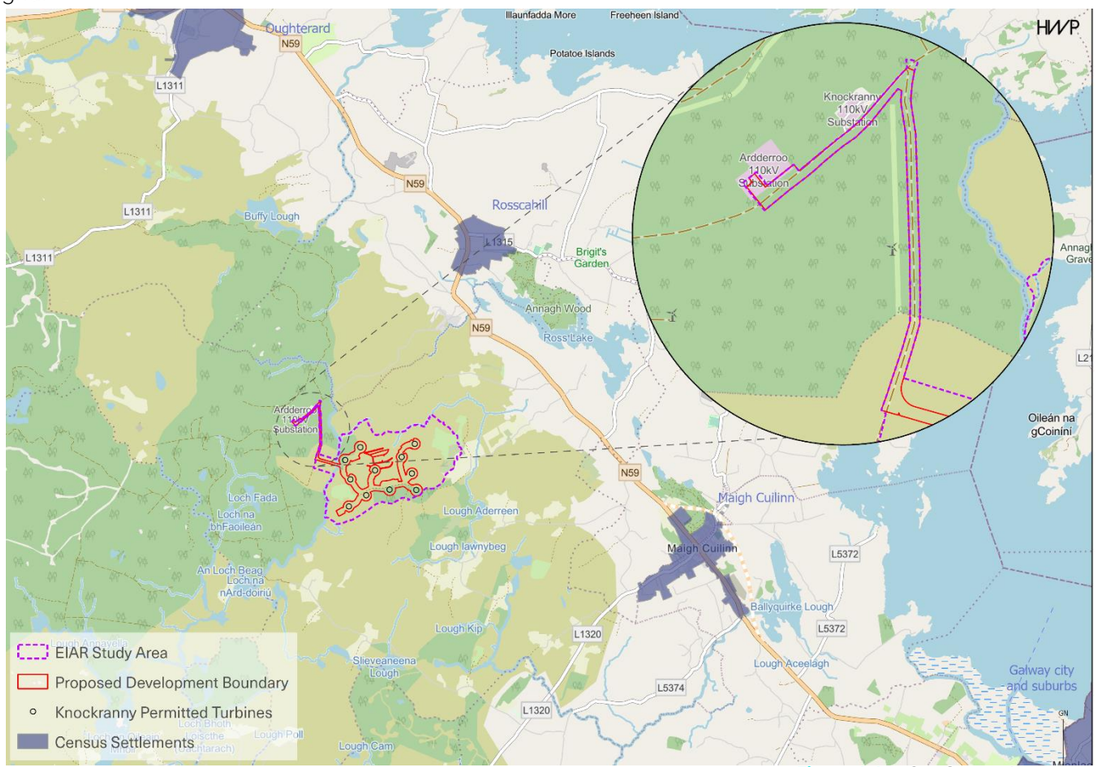

Figure 1.1 Site Context Map

[1] As permitted under reference PA07.303086/303086.

Chapter 2 of this EIAR includes a detailed description of the project and proposed development, with the following summary key definitions applied to ensure consistency of referencing and assessment approach throughout this report.

- 'Permitted Development': The wind farm development granted planning permission under Galway County Council Reference No. 13/829 and An Bord Pleanála Reference No. 07.243094 (as described under Section 2.2 of this report).
- 'Proposed Development': The development for which planning permission is now being sought from Galway County Council comprising specified proposed alterations to Galway County Council Reference No. 13/829 / An Bord Pleanála Reference No. 07.243094, including the proposed underground electrical and communications cabling connecting the 11 no. wind turbines to the Ardderroo substation, as well as extension to substation control building and new step up transformer (as described under Section 2.3 of this report).
- 'Project': Where reference is made to the 'Project', this comprises the Permitted Development and Proposed Development as defined above. This is the collective Cnoc Raithní (Knockranny) Wind Farm project.

The application for consent is being made under Section 34 of the Planning and Development Act 2000 (as amended). This EIAR has been completed in accordance with Directive 2011/92/EU (as amended by 2014/52/EU) and relevant Irish legislation[2] as well as in conformity with guidance in the European Commission's 'Environmental Impact Assessment of Projects Guidance on the preparation of the Environmental Impact Assessment Report' (2017) and EPA's 2022 'Guidelines on the Information to be Contained in Environmental Impact Assessment Reports' (EPA 2022 Guidelines).

The Proposed Development, in combination with the Permitted Development (Project), will comprise a development area of 77.92 hectares in the townlands of Knockranny, Letter and Ardderroo. The EIAR study area comprises of 331 hectares and is located approximately 3km south-west of Roscahill Village, 4.5 kilometres north-west of the settlement of Moycullen and c.2.5 kilometres west of the N59 (Galway – Clifden) National Secondary Road. Ardderroo Wind Farm (currently under construction), the Galway Wind Park and a number of other wind farms exist to the west and south. A full description of the proposed development is provided in Chapter 2 of this EIAR. The site's location within the wider context is illustrated in Figure 1.1 as shown.

1.2. Need for the Project

As outlined, planning permission already exists for an 11 no. turbine windfarm at this location, with the principle of development firmly established. A pre-construction technical review of the Permitted Development identified the need for some focused design changes to the wind farm itself, including a revised means of grid connection. Due to changes in local grid infrastructure in the intervening years, it is now proposed to make the grid connection from the Permitted Development to the 110kV Ardderroo substation (as permitted under PA 07.303086). As a result of this, the permitted on-site substation at Cnoc Raithni (Knockranny) wind farm is no longer necessary and will be omitted.

Similarly, having regard to advances in turbine technology since 2013, revised turbine dimensions are also proposed in lieu of that previously assessed in the EIS for the Permitted Development, which comprised of 6 no. turbines with a maximum tip height of 140.5 metres (T5, T6, T7, T11 and T14) and 5 no. turbines with a maximum

[2] Part X of the Planning and Development Act 2000, as amended, and the Planning and Development Regulations, 2001, as amended.

blade tip height of 130.5 metres (T1, T2, T3, T8 and T13). As outlined in Chapter 2 of this EIAR, two proposed candidate turbines are being considered in respect of this.

At a strategic level, the need for the overall project is supported by International, European, and National environmental and energy commitments and policies. In December 2015, the Paris Agreement was adopted by 189 countries, with the key goal to limit the increase in global average temperature to below 1.5 degrees over pre-industrial levels. The Intergovernmental Panel on Climate Change (IPCC) has stated that a "virtually full" decarbonisation of the global power sector is needed by around 2050 to meet this target. Worryingly, Ireland's consumption of natural gas has increased in recent years at a time when consumption growth has been reducing on average across the rest of Europe.

The Government's Climate Action Plan 2023 sets the national targets for renewable electricity at 80 % by 2030, up from the 2020 rate of 42% and to reach net-zero emissions by no later than 2050. In terms of the security of energy supply, Ireland is one of the most energy import-dependent countries in the EU which carries significant risks, a point underlined by the recent war in Ukraine. In order to reduce its import dependency, Ireland must increase the level of energy from a diverse number of renewable energy sources. The proposed development will contribute importantly to this, reducing Ireland's reliance on fossil fuels by supplying a sustainable form of renewable energy.

1.3. Purpose of EIA

EIA requirements are now governed by Directive 2014/52/EU, which amends Directive 2011/92/EU ("the EIA Directive"). The primary function of the EIA Directive is to ensure that projects that are likely to have significant effects on the environment are subjected to an assessment of their likely impacts.

Ireland's obligations under 2011 "the EIA Directive" have been transposed into Irish law and, in particular, the planning consent process through the provisions of Part X of the Planning and Development Act 2000, as amended, and the Planning and Development Regulations, 2001, as amended. Subsequently, the 2014 amendments have been transposed into the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018).

Article 1(1)(g) of the 2014 EIA Directive (2014/52/EU) outlines the stages and steps taken when completing an EIA.

> *(i) the preparation of an environmental impact assessment report by the developer, as referred to in Article 5(1) and (2);*
>
> *(ii) the carrying out of consultations as referred to in Article 6 and, where relevant, Article 7;*
>
> *(iii) the examination by the competent authority of the information presented in the environmental impact assessment report and any supplementary information provided, where necessary, by the developer in accordance with Article 5(3), and any relevant information received through the consultations under Articles 6 and 7;*
>
> *(iv) the reasoned conclusion by the competent authority on the significant effects of the project on the environment, taking into account the results of the examination referred to in point (iii) and, where appropriate, its own supplementary examination; and*
>
> *(v) the integration of the competent authority's reasoned conclusion into any of the decisions referred to in Article 8a.*

This is reflected in Article 171A of the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 which states that 'Environmental Impact Assessment' means a process–

> *(a) consisting of–*
>
> *(i) the preparation of an environmental impact assessment report by the applicant in accordance with this Act and regulations made thereunder,*
>
> *(ii) the carrying out of consultations in accordance with this Act and regulations made thereunder,*
>
> *(iii) the examination by the planning authority or the Board, as the case may be, of–*
>
> *(I) the information contained in the environmental impact assessment report,*
>
> *(II) any supplementary information provided, where necessary, by the applicant in accordance with section 172(1D) and (1E), and*
>
> *(III) any relevant information received through the consultations carried out pursuant to subparagraph (ii)*
>
> *(iv) the reasoned conclusion by the planning authority or the Board, as the case may be, on the significant effects on the environment of the proposed development, taking into account the results of the examination carried out pursuant to subparagraph (iii) and, where appropriate, its own supplementary examination, and*
>
> *(v) the integration of the reasoned conclusion of the planning authority or the Board, as the case may be, into the decision on the proposed development, and*
>
> *(b) which includes–*
>
> *(i) an examination, analysis and evaluation, carried out by the planning authority or the Board, as the case may be, in accordance with this Part and regulations made thereunder, that identifies, describes and assesses, in an appropriate manner, in the light of each individual case, the direct and indirect significant effects of the proposed development on the following:*
>
> *(I) population and human health;*
>
> *(II) biodiversity, with particular attention to species and habitats protected under the Habitats Directive and the Birds Directive;*
>
> *(III) land, soil, water, air and climate;*
>
> *(IV) material assets, cultural heritage and the landscape;*
>
> *(V) the interaction between the factors mentioned in clauses (I) to (IV), and*
>
> *(ii) as regards the factors mentioned in subparagraph (i)(I) to (V), such examination, analysis and evaluation of the expected direct and indirect significant effects on the environment derived from the vulnerability of the proposed development to risks of major accidents or disasters, or both major accidents and disasters, that are relevant to that development.*

This EIAR has been prepared in accordance with the relevant provisions of the EIA Directive, the Planning and Development Acts and Planning and Development Regulations. In addition, the EIAR conforms to the guidance contained in the relevant EU and Irish guidance in respect of the preparation of an EIAR.

The objective of the EIA Directive is to ensure a high level of protection of the environment and human health, through the establishment of minimum requirements for EIA, prior to development consent being given, of developments that are likely to have significant effects on the environment.

In addition to the legislation and guidelines referenced above, the Department of Housing, Local Government and Heritage's 'Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment' (2018) provide practical guidance to An Bord Pleanála on procedural issues and the EIA process, and outline the key changes introduced by Directive 2014/52/EU.

The EPA 2022 Guidelines list the following fundamental principles to be followed when preparing an EIAR:

- Anticipating, avoiding and reducing significant effects;
- Assessing and mitigating effects;
- Maintaining objectivity;
- Ensuring clarity and quality;
- Providing relevant information to decision makers; and
- Facilitating better consultation.

The amended EIA Directive prescribes a range of environmental factors which are used to organise descriptions of the environment and the environmental impact assessment should identify, describe and assess in an appropriate manner, in the light of each individual case, the direct and indirect significant effects of a project on the prescribed environmental factors which are:

(a) population and human health;

(b) biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC;

(c) land, soil, water, air and climate;

(d) material assets, cultural heritage and the landscape;

(e) the interaction between the factors referred to in points (a) to (d).

This EIAR documents the assessment process of the prescribed environmental factors in relation to the Proposed Development.

1.4. EIA Methodology

As per Article 5(1) of the 2014 Directive, an EIAR should provide the following information:

- Description of Project;
- Description of Baseline Scenario;
- Description of Likely Significant Effects;
- Description of Avoidance / Mitigation Measures;
- Description of Reasonable Alternatives (and rationale for chosen option); and
- A Non-Technical Summary.

Annex IV of the Directive sets out a more detailed outline of the information required in an EIAR. The subject EIAR has been prepared in full accordance with these stated requirements of Annex IV.

In addition to the 2014 Directive, this EIAR has been informed by, but not limited to:

- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment, (Department of Housing, Local Government and Heritage, August 2018).
- EPA 2022 Guidelines;
- Environmental Impact Assessment of Projects: Guidance on Scoping (European Commission, 2017);
- Environmental Impact Assessment of Projects: Guidance on the Preparation of the Environmental Impact Assessment Report (European Commission, 2017);
- Advice Notes for Preparing Environmental Impact Statements, Draft, (EPA, September 2015);
- Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment (European Union, 2013).
- Transposition of 2014 EIA Directive (2014/52/EU) in the Land Use Planning and EPA Licensing Systems - Key Issues Consultation Paper, Department of Housing, Planning, Community and Local Government, 2017.
- Circular letter PL 1/2017 - Advice on Administrative Provisions in Advance of Transposition (2017).

We would also note that the pre-application discussions with the Planning Authority informed the content of the EIAR. The EIA process has been managed to ensure that the EIAR documentation and relevant analysis are confined to topics which are explicitly described in the legislation, and where environmental impacts may arise. Evaluation and analysis have been limited to topics where the indirect, secondary or cumulative impacts are either wholly or dominantly due to the project under consideration.

The EIA process can be broadly described as set out in figure 1.2 as shown.

1.5. EIA Screening & Scoping

Screening is the term used to describe the process for determining whether a proposed development requires an EIA by reference to mandatory legislative threshold requirements or by reference to the type and scale of the proposed development and the significance or the environmental sensitivity of the receiving baseline environment. Article 93 of, and Schedule 5 to, the Planning and Development Regulations 2001 set out the classes of development for which a planning application must be accompanied by an environmental impact assessment report (EIAR). Part 1 and Part 2 Schedule 5 of the Planning and Development Regulations, 2001, as amended, prescribes the categories of, and thresholds for, prescribed development requiring EIA.

Schedule 5 Part 2 states that an EIA is required for:

> *"3. Energy Industry*
>
> *Installations for the harnessing of wind power for energy production (wind farms) with more than 5 turbines or having a total output greater than 5 megawatts."*

Accordingly, an Environmental Impact Statement (EIS) was prepared for the Cnoc Raithní (Knockranny) Wind Farm (as permitted under Galway County Council Reference 13/829 / An Bord Pleanala Reference PL07.243094) in accordance with Section 172(1) of the Planning Act and Schedule 5 of the Planning Regulations.

As detailed in Chapter 2 of this EIAR, the Proposed Development will result in an increase to the total output of the Permitted Development from a previously considered export capacity of 33MW to between 47MW and 49MW dependent on the final turbine selection. As the Proposed Development will result in a potential increase in generating capacity of greater than 5 MW, as per Schedule 5, Part 2 of the Planning and Development

Regulations, 2001, in the interests of best practice and providing a comprehensive assessment for all relevant environmental considerations, the Proposed Development application is supported by this EIAR.

EIA Scoping is the process of determining the content and extent of the matters which should be considered in the environmental information contained in an EIAR.

Figure 1.2 EIA Process (Source: Page 12 of Preparation of guidance documents for the implementation of EIA Directive (Directive 2011/92/EU as amended by 2014/52/EU).

The EPA 2022 Guidelines state that scoping is a process of deciding what information should be contained in an EIAR and what methods should be used to gather and assess that information. Scoping is defined in the European Commission EIAR guidance (EC, 2017) as:

"The process of identifying the content and extent of the information to be submitted to the Competent Authority under the EIA process."

The content of this EIAR was informed by an informal scoping process carried out by the applicant, the design team and appointed EIAR consultants to identify the core issues likely to be most important during the Environmental Impact Assessment process.

In determining the extent and content of this EIAR, the authors have carefully considered the applicable EU and Irish legislative requirements, relevant EU and Irish guidance and pre-planning consultation meetings held with Galway County Council in accordance with Section 247 of the Planning and Development Act 2000 on the 25th of January 2023. In addition, the following prescribed bodies were notified of the extent of the proposed development and of the fact that an EIAR was being prepared:

1. Department of for Housing, Local Government and Heritage
2. Department of Environment, Climate and Communications
3. Department of Transport
4. Department of Tourism, Culture, Arts, Gaeltacht, Sport and Media
5. Department of Agriculture, Food and the Marine
6. National Transport Authority
7. Transport Infrastructure Ireland
8. Arts Council (Chomhairle Ealaíon)
9. The Heritage Council
10. Health Service Executive
11. Geological Survey of Ireland
12. Environmental Protection Agency
13. Northern and Western Regional Assembly
14. National Parks and Wildlife Service
15. An Taisce
16. Inland Fisheries Ireland
17. Office of Public Works
18. Fáilte Ireland
19. Irish Water
20. Waterways Ireland
21. Health and Safety Authority

E-copy notification was issued in December 2022, with a follow up hard copy issued in January 2023. The letters sent to the above bodies are contained in Appendix 1-1 with any responses received contained in Appendix 1-2.

In addition to the above, and as outlined in this report, the preparation of individual chapters has been informed by further focused engagement with prescribed and other bodies. This included Met Eireann and the Irish Aviation Authority, among others.

The preparation of the Proposed Development has been subject to community engagement, with a summary report on same contained in Appendix 1-4.

1.6. Structure of the EIAR

The primary purpose of this EIAR is to inform the EIA process, by identifying likely significant environmental impacts resulting from the Proposed Development, to describe the means and extent by which they can be reduced or mitigated, to interpret and communicate information about the likely impacts and provide an input into the decision-making planning process.

The EIAR document provides information on any identified effects arising as a consequence of the Proposed Development. The EIAR documents the manner in which the project design incorporated mitigation measures; including impact avoidance, reduction or amelioration; to explain the manner in which significant effects will be avoided.

The key purpose of this EIAR document is to enable the competent authority to form a reasoned conclusion, in the context of the decision-making process, on the significant effects of the project on the environment, based on the examination of the EIA Report.

Pursuant to the provisions of Article 5(1) of the EIA Directive, where an environmental impact assessment is required, the developer shall prepare and submit an EIAR which shall include at least:

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

The EIAR shall include the information that may reasonably be required for reaching a reasoned conclusion on the significant effects of the project on the environment, taking into account current knowledge and methods of assessment. In addition, the developer shall, with a view to avoiding duplication of assessments, take into account the available results of other relevant assessments under European Union or national legislation, in preparing the EIAR.

This EIAR is divided into 3 volumes:

- The non-technical summary comprising a concise, but comprehensive description of the project, its environment, the effects of the project on the environment, the proposed mitigation measures, and the proposed monitoring arrangements;
- The main report consisting of 16 chapters as outlined in the table of contents;
- The Appendices numbered in accordance with the chapter they relate.

Each chapter includes the following elements:

Introduction and Methodology

Description of Existing Environment/Baseline Scenario

Impact Assessment which considers the following effects as necessary.

- Indirect Effects
- Cumulative Effects.
- Do-Nothing Effects
- Worst Case Effects
- Indeterminable Effects
- Synergistic Effects

Mitigation Measures (including Monitoring) – Description of mitigation measures proposed for both construction and operational phases of the proposed development.

Residual Impacts

Identify, and assess significance of, any residual impacts.

Difficulties in Compiling Information - Any difficulties/restrictions on gathering information if applicable is stated.

References - Any external references in the report cited and listed at the end of each chapter.

All impacts or effects are described in following terms in accordance with the "*Description of Effects*" outlined in Table 3.4 of the EPA 2022 Guidelines.

Quality: Positive, Neutral, Negative/Adverse

Significance: Imperceptible, Not Significant, Slight, Moderate, Significant, Very Significant, Profound

Extent and Context: Size of area, population etc., whether conforms or contrasts with established conditions.

Probability: Likely, unlikely

Duration: Momentary (seconds to minutes); Brief (less than a day), Temporary <1 yr; Short-term 1-7 yrs, Medium Term 7-15yrs, Long Term 15-60 yrs, Permanent >60 yrs, Reversible (can be undone), Frequency (once, rarely, occasionally, frequently, constantly or hourly, daily, weekly, monthly, annually).

A Natura Impact Statement (NIS) has also been prepared by Greenleaf Ecology – Environmental Consultants regarding the Proposed Development and is enclosed in Appendix 9.1. Following a comprehensive evaluation of the potential direct, indirect and cumulative impacts on the qualifying interests of the European Sites in the vicinity and the implementation of the proposed mitigation measures, the NIS concludes that the Proposed Development will not have any adverse effects on the integrity of any European Sites.

European Sites in the vicinity include: Connemara Bog Complex SAC 002034, Ross Lake and Woods SAC (001312), Gortnandarragh Limestone Pavement SAC (001271), Connemara Bog Complex SPA (004181), Lough Corrib SAC (000297), Lough Corrib SPA (004042), Lough Corrib Ramsar Site (Ramsar Site Number: 846), Galway Bay Complex SAC (000268), Inner Galway Bay SPA (004031) and the Inner Galway Bay Ramsar Site (Ramsar Site Number: 838).

1.7. Planning History

The previous planning applications within the Proposed Development boundary are:

1.7.1. Knockranny Windfarm

Wind Farm

- **Pl. Ref. 11/375:** Application by Western Power Developments Ltd. for the construction of a wind farm comprising of 14 no. turbines and ancillary works at Knockranny and Adderroo adjoining the eastern boundary of the current proposal. Permission was granted by the Planning Authority but refused by An Bord Pleanála (PL.07.239053) in August 2012.
- **Pl. Ref. 13/829:** Application by Western Power Developments Ltd. for the construction of a wind farm consisting of 11 no. turbines and ancillary works and Knockranny adjoining the eastern boundary of the current proposal. Permission was granted by the Planning Authority in February 2014 and granted on appeal to An Bord Pleanála in February 2016.

Met Mast

- **Pl. Ref: 00/3564**: Application for the construction of a wind monitoring systems of 30 metres in Knockranny. Permission was granted by the Planning Authority in September 2000.
- **Pl. Ref: 08/3813**: Application for the construction of a 60 metre high wind monitoring mast in Knockranny. Permission was granted by the Planning Authority on the 24th of February 2009.

Road Access Upgrades

- **Pl. Ref. 13/658** application by SSE Renewables for a modification and improvements to existing roads and tracks for the Galway Wind Park turbine delivery route. This application was granted by Galway County Council on the 25th of July 2013. The permission provides for the modification and improvement to 8.06 kilometres of the Doon Road, including the junction of the Doon Road with the N59. Of the 8.06 kilometres of road improvements, 4.86 kilometres are within the proposed Ardderroo wind farm site boundary. These modifications and improvements have been completed.

Adjacent Ardderroo Wind Farm and Substation

- **PA07.303086** - Section 37E, Strategic Infrastructure Development application for the construction of up to 25 number wind turbines, one permanent meteorological mast, one 110kV substation and all associated site development works. Permission was granted on the 17th July 2019.
- **PM07.308302**: Application by Ardderroo Windfarm Ltd under Section 146B of Planning & Development Act 2000 (as amended) for alterations to reference PA07.303086 comprising amendments to route of internal electrical cabling, internal road, electricity substation and ancillary works. Permission was granted to alter PA07.303086 on 23rd November 2020.

1.8. The Applicant

The Project is being advanced by Western Power Developments Limited, an associate company of Enerco Energy Ltd. which is 100% Irish-owned and based in Cork, with extensive experience in the design, construction and operation of renewable energy developments throughout Ireland.

They have projects currently operating or in construction in counties Cork, Kerry, Limerick, Clare, Galway, Mayo and Donegal. By Q1 2023, Enerco Energy Ltd. and their associated companies had over 825 MW of wind generating capacity in commercial operation/ in construction, with a further 400MW of projects at various stages in its portfolio to assist in meeting Ireland's renewable energy targets. Ardderroo Wind Farm is part of the Enerco portfolio.

Given its significant renewable energy track-record, particularly in terms of wind energy, the applicant is already playing a leading role in the transition to a low carbon future and have the experience and capabilities to continue to support Ireland in this transition over the coming years.

Renewable energy projects can have multiple long-term benefits, nationally and regionally in terms of carbon reduction, but also in terms of the local communities in which they are located. The applicant recognises the important role of positive engagement with local communities to ensure renewable energy projects are developed which are socially and environmentally appropriate and of benefit to all.

1.9. EIAR Team & Qualifications

HW Planning have coordinated the subject EIAR. Environmental specialist consultants were also commissioned for the various technical chapters of the EIAR document which are mandatorily required as per the EIA Directive and Planning and Development Regulations 2018 (ref. Section 1.3).

The amended EIA Directive (Directive 2014/52/EU) states the following in relation to the persons responsible for preparing the environmental impact assessment reports:

> *'Experts involved in the preparation of environmental impact assessment reports should be qualified and competent. Sufficient expertise, in the relevant field of the project concerned, is required for the purpose of its examination by the competent authorities in order to ensure that the information provided by the developer is complete and of a high level of quality".*

Each environmental specialist was required to characterise the receiving baseline environment; evaluate its significance and sensitivity; predict how the receiving environment will interact with the proposed development and to work with the EIA project design team to devise measures to mitigate any adverse environmental impacts identified.

In accordance with the EIA Directive 2014/52/EU, we confirm that the EIAR has been carried out by fully qualified and competent experts in their relevant fields as outlined in this chapter. A full list of all consultants and the corresponding chapters that have been prepared is detailed below.

Planning Consultants: HW Planning

Address: 5 Joyce House, Barrack Square, Ballincollig, Co. Cork

Chapters Prepared: Chapter 1 – Introduction, Chapter 2 - Project Description, Chapter 3 - Alternatives Considered, Chapter 14 - Population & Human Beings, Chapter 15 - Interaction of Impacts and Chapter 16 - Summary of Mitigation Measures

Personnel: Conor Frehill, (BA HONS, Master of Regional and Urban Planning, MRTPI), Director at HW Planning. Conor has 14 years' experience in the planning profession comprising local authority roles and private practice. Conor has acted as planning lead on a wide variety of projects, including those with Environmental Impact Assessment Reports and Strategic Environmental Assessment exercises. His experience extends to planning policy development, local authority plan-making processes, the preparation of evidenced based strategies, leading on community-led planning initiatives, and the coordination of planning applications for mixed use developments, strategic infrastructure and renewable energy projects. Conor is a chartered member of the Royal Town Planning Institute.

Landscape Architects: Macro Works Ltd.

Address: Cherrywood Business Park, Loughlinstown, Dublin 18

Chapters Prepared: Chapter 4 – Landscape & Visual

Personnel: Macro Works was founded in 1999 and is a consultancy firm specialising in Landscape and Visual Assessment and associated maps, graphics and verified photomontages. Relevant experience includes LVIA for over 150 wind energy developments in Ireland to date. This LVIA was undertaken jointly by Richard Barker and Jorden Derecourt. Richard is the Principal Landscape Architect at Macro Works Ltd and has 19 years' experience. Jorden is a Landscape Architect with 6 years' experience. Both have master's degrees in landscape architecture and are full members of the Irish Landscape Institute.

Project Civil Engineer/Traffic Consultants: JB Barry & Partners

Address: 3 Eastgate Road, Eastgate Business Park, Little Island, Co. Cor, T45 KH74

Chapters Prepared: Chapter 5 - Material Assets – Traffic & Transportation Services, Chapter 7 – Land and Soils), Chapter 8 – Water (Hydrology & Hydrogeology.

Personnel: Alan Moriarty (Chapter 5) is a Chartered Civil Engineer and a Design Engineer – Traffic with J.B. Barry and Partners with 13 years' experience in the private sector as a consulting engineer with particular experience in design and construction of infrastructure for residential developments. He holds an MSc in Civil Engineering from Trinity College Dublin.

Niall O'Brien (Chapter 7) is a Chartered Geotechnical Engineer with J. B. Barry and Partner and over nine years' experience in the geotechnical design in the earthworks for infrastructure and on-shore renewables projects including the design of piled and spread foundations for wind turbines, substation platforms, reinforced earth walls, piled embankments, pile walls, borrow pit appraisals, unbound access tracks and temporary platforms, embankment design, ground investigation supervision and ground modelling, CAT III checking of on-shore wind farms and road infrastructure. Niall holds an MSc in Soil Mechanics from Imperial College London.

Kieran O'Dwyer (Chapter 8) is a Director with J. B. Barry and Partners and has over 40 years' experience in the field of environmental and hydrogeological consultancy. He was formerly a director with K. T. Cullen and Co. Ltd (Environmental Consultants) and a Regional Director with WYG Ireland. Kieran has been responsible for the Land Soils and Hydrogeology element of numerous Environmental Impact Assessments (including TII tranche 4 motorway service areas (3 No.), NRA Tranche 4 Motorway Service Areas (5 No. oral hearings) and Ringsend Wastewater Treatment Plant Upgrade Project) and has presented specialist evidence at numerous oral hearings.

Environmental Engineers: Malachy Walsh & Partners Consulting Engineers

Address: Reen Point, Blennerville, Tralee, Co. Kerry, Ireland.

Chapters Prepared: Chapter 6 - Material Assets – Infrastructure & Utilities and Shadow Flicker Assessment (Appendix 14.1).

Personnel: Caitriona Fox – Material Assets (Built Services) EIAR Chapter, Shadow Flicker Assessment and Reviewer

Caitriona (BA, MSc) is a Senior Environmental Consultant with over 20 years environmental consultancy experience. She is an environmental impact assessment practitioner and has taken on the role of EIA Project Manager for a variety of large scale EIA projects including wind farms such as Drumnahough Wind Farm, Knockranny/Cnoc Raithní Wind Farm and Leanamore Wind Farm. She has extensive experience in the management and compilation of environmental reports and has authored numerous specialist reports including: air and climate impact assessments, population and human health assessments including shadow flicker assessment, landscape impacts assessment, and material assets assessment for project EIAs.

Roman Puotkalis – Material Assets (Built Services) EIAR Chapter
Roman Puotkalis (BSc, MSc), is an Environmental Consultant with MWP. He holds an MSc in Environmental Analytical Chemistry and a BSc (Hons) Environmental Science from University College Cork. Roman has been involved in geo-environmental investigation/interpretation and hydrogeological investigation and assessments. Roman has written EIAR chapters for various projects which included assessment of environmental impact on Land, Soils, Geology, and Hydrogeology as well as cumulative impacts with various other aspects of the environment. He has also worked on Environmental Site Assessments for several projects including substations, wind farm infrastructure, power generating stations and manufacturing facilities which included assessing impacts of developments on human health and the environment.

Jeremy King –Planning Application Drawings
Jeremy (Cert IA, Cert CAD, HDip) is the lead Civil, Environmental and GIS technician in MWP, with over 16 years' experience in this field. He assists the environmental team in completing EIAR's, wind farm feasibility studies and planning applications. He also works alongside the wind farm civils design team, particularly in constraint mapping and collating and generating GIS baseline data that ultimately influences design and layout. Jeremy works with the EIA team specialists. He has expertise in WINDFARM design software that includes modules on wind farm layout, Photomontages, ZVI and Shadow Flicker. He has worked with the Senior Environmental Consultant in generating shadow flicker models on numerous wind farm projects.

Project Ecologist: Greenleaf Ecology – Environmental Consultants

Address: Coolnacaheragh, Lissacresig, Macroom, Co. Cork, Ireland

Chapters Prepared: Chapter 9 - Biodiversity, Chapter – 10 Ornithology

Personnel: Greenleaf Ecology and Lauren Williams

Karen Banks. Karen is the principal ecologist with Greenleaf Ecology and has 16 years' professional consultancy experience in the field of ecological field survey and environmental impact assessment. She holds a BSc (Hons) in Environment and Development from Durham University and is a full member of the Chartered Institute of Ecology and Environmental Management. Karen has extensive experience in the production of biodiversity chapters for inclusion within Environmental Impact Assessment (EIA), Appropriate Assessment Screening Reports and Natura Impact Statements including those for transport infrastructure, small to large scale housing and mixed use developments, flood alleviation schemes and wind farms.

Lauren Williams BSc PGDip MCIEEM is a qualified freshwater ecologist with over 20 years professional consultancy experience working in New Zealand (2yrs) and in Ireland (past 18yrs). Lauren holds a BSc in Zoology (University of Otago, NZ); a Certificate in Environmental Law (Open Polytechnic of NZ) and a Post Graduate Diploma in Environmental Monitoring Assessment and Engineering, with Distinction, from Trinity College Dublin. She is a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM). Lauren specialises in water quality assessment, monitoring, aquatic ecological impact assessment and protected aquatic species and habitat surveys; regularly undertaking specialised aquatic field studies and preparing EcIA reports and EIAR chapters, plus Appropriate Assessment reporting (AA Screening/NIS) in relation to a range of large infrastructural developments.

Technical Specialist - Air Quality and Climate and Noise and Vibration: AWN Consulting

Chapters Prepared: Chapter 12 Air Quality and Climate, 13 - Noise

Personnel: Chapter 12 was completed Dr. Avril Challoner. Avril is a Principal Consultant in the Air Quality section of AWN Consulting, with over 10 years consultancy experience. She holds a BEng (Hons) in Environmental Engineering from the National University of Ireland Galway, HDip in Statistics from Trinity College Dublin and has completed a PhD in Environmental Engineering (Air Quality) in Trinity College Dublin. She is a Chartered Scientist (CSci), Chartered Environmentalist (CEnv), Member of the Institute of Environmental Management and Assessment, Member of the Institute of Air Quality Management and specialises in the fields of air quality, EIA and climate assessments.

She has prepared the air quality and climate EIAR chapters for a wide range of projects including several wind farm developments and high profile public transport projects including BusConnects, Waterford Airport and the Metrolink. In addition, she is a guest lecture in Trinity College Dublin as part of Engineers Ireland Environmental Essentials for Engineering Projects CPD Programme and for the Environmental Engineering Masters.

Chapter 13 was completed by Mike Simms, Principal Acoustic Consultant in the Acoustic Section of AWN Consulting. Mike holds a BE and M. Eng Sc in Mechanical Engineering and is a member of the Institute of Acoustics (MIOA) and of the Institution of Engineering and Technology (MIET). he has worked in the field of acoustics for over 20 years, with extensive experience in all aspects of environmental surveying, noise modelling and impact assessment for various sectors including, wind energy, industrial, commercial and residential.

Built Heritage/Archaeology: Laurence Dunne Archaeology Ltd

Address: 3, Lios na Lohart, Ballyvelly, Tralee, Co. Kerry.

Chapters Prepared: Chapter 11 - Cultural Heritage

Personnel: Laurence Dunne has over twenty years' experience in an extensive and diverse range of terrestrial and underwater projects. His company undertakes all archaeological work including monitoring, test and full excavation, Environmental Impact Assessment Reports (EIAR's), renewable energy projects including wind and solar fam projects, graveyard surveys and topographic surveys. They also undertake unmanned aerial vehicle (UAV) services including: – aerial surveys, high res. photo/video, orthomosaics. Laurence has a long established track record in the preparation of archaeological impact assessment reports (AIAs) which form a major component of planning applications.

1.10. Cumulative Impacts

The potential environmental effects of the Proposed Development have not been assessed in isolation. The potential impacts of this project have been considered in combination with other relevant permitted or proposed projects in the vicinity of the site and plans for the area, which may result in cumulative environmental impacts.

The geographical boundaries for cumulative projects were developed within the wider design team having regard to the location of the Project; defined EIAR boundary; the nature of the Proposed Development works; the receiving environment; and the potential for cumulative impacts to arise relative to each individual EIAR topic chapter. In relation to the latter, this included consideration of the following practical elements:

- Population and Human Health: Consideration of appropriate shadow flicker study area (10 x rotor diameters from proposed turbines);
- Biodiversity: Consideration of terrestrial ecology habitats and survey work within the environs of the site, including bird surveys;
- Air and Climate: The extent to which dust can travel impacting air quality (typically no greater than 500 metres);
- Noise: The extent to which the Proposed Development could interact with other wind farm projects to contribute to cumulative noise effects;
- Cultural Heritage: The record of known archaeological heritage features in the area;
- Water: Surface water catchments and hydrological cumulative impact potential based on the Proposed Development;
- Material Assets: Potential for cumulative telecoms, broadcast and aviation impacts, and impact of Proposed Development on traffic volumes in the area, inclusive of other known projects and having regard to the delivery route for construction traffic.
- Landscape and Visual: Zone of theoretical visibility and extent to which the Proposed Development could contribute to visual effects or effects on landscape character.

Based on a review of associated matters, a general search radius of 10km was considered reasonable and adopted. Where appropriate, the chapters of this EIAR also consider parameters relevant to individual topics. For example, Chapter 4 Landscape and Visual Impact utilises a 20km radius, however, Section 4.9.3 notes that little influence is exerted beyond the central study area of 5km. The necessity to define the Chapter 14 Population and Human Health study area using Census boundaries, has extended the area beyond 10km in places, however, the assessment is largely focussed within the 10km area.

Currently under-construction or proposed future local transport projects were considered in the context of the traffic and transport assessment. Due to the scale and nature of local domestic and/or agricultural projects, a 2.5km radius on known permitted/yet to be constructed projects has been applied in consideration of population, health, and other environmental criteria.

1.10.1. Cumulative Projects

Each of the projects listed in tables 1.1, 1.2 and 1.3 have been assessed for potential cumulative impacts. These projects were identified by using Galway County Council's Planning Enquiry Systems, An Bord Pleanála's website and the Department of Housing, Local Government and Heritage's EIA Portal.

Projects	Proximity to Development Lands	Description	Status
The proposed N59 Maigh Cuilinn (Moycullen) Bypass Road Project	4km	Comprises the construction of a 4.3km standard single carriageway road bypass of Maigh Cuilinn (Moycullen) village and all ancillary works	Under construction
The Connemara Greenway	2km	The Connemara Greenway comprises the development of the dismantled Galway to Clifden railway line into a walking/cycling track (Greenway) between Oughterard and Clifden, over an approximate distance of 52.4km. Permission for the proposed Greenway Development was granted by An Bord Pleanála on the 20th of February 2013. The 2022 Draft CycleConnects Plan makes provision for a continuation of this greenway from Oughterard	Proposed

		to Galway City. This is supported in Galway County Development Plan Policy. The CycleConnects plan is due to be finalised and adopted in March 2023 with implementation following on after April 2023.	

Table 1.1 Cumulative Impacts – Nearby Transport Projects Considered

Projects	Owner	No. of Turbines	Proximity to Development Lands	Description	Status
Ardderroo Wind Farm	Ardderroo Windfarm Ltd	25	27m	**PA07.303086/303086 -** Construction of up to 25 number wind turbines, one permanent meteorological mast, one 110kV substation and all associated site development works (as amended by references ABP 308302 and 314439).	Under construction
Inverin	Fuinneamh Teoranta	5	10 km southwest	**Pl. Ref: 96/1684:** Application to construct a windfarm comprising 5 wind turbines in Inverin. Permission was granted in January 1997.	Existing
Galway Wind Park (overall 69 consented and 60 constructed) **Cloosh**	Coillte Teoranta and SSE Renewables (Ireland)Ltd	22 Consented 20 Constructed	4.3km west	**Pl. Ref: 10/303:** Construction of a wind farm comprising 22 no. wind turbines with a maximum tip of 140.5 metres and associated infrastructure in Finnaun. Permission was granted by the Planning Authority in June 2010. Of the 22 no. permitted wind turbines, 20 have been constructed and are now operational. Extension of duration granted on 2/4/2020. This wind farm forms part of the Galway Wind Park.	Existing
Galway Wind Park - Uggool	SSE Renewables (Ireland) Ltd	16 Constructed	2.6km northwest	**Pl. Ref. 11/1735**, as amended by the subsequent permissions under **Pl. Ref. 13/460** and **Pl. Ref. 14/1423**. This wind farm forms part of the Galway Wind Park development	Existing
Galway Wind Park Seecon	Coillte Teoranta and SSE Renewables (Ireland) Ltd	23 Consented 16 Constructed	5.2km southwest	**Pl. Ref: 11/429**: Application by Coillte Teoranta and SSE Renewables Ltd. for the construction of 23 no. wind turbines in Seecon. Permission was granted by the Planning Authority in March 2011. This was appealed to An Bord Pleanála and granted in November 2011 under Pl.07.239118. Of the 23 no. permitted turbines 16 no. have been constructed and are now operational. This wind farm forms part of the Galway Wind Park.	Existing
Galway Wind Park Seecon and Cloosh	Coillte Teoranta and SSE Renewables (Ireland) Ltd	9	3km west	**Pl. 19/1481**: application for a 10 year permission for development at Derradda, Seecon, Shannapheasteen, Uggool, Letter, Finnaun consisting of a change to the dimensions of nine previously consented turbines (Galway County Council Planning Reference 10/303 and 11/429 and An Bord Pleanala Planning Reference PL07.239118) from a maximum hub height of 90m and rotor diameter of 101m with a maximum turbine tip height of 140.5m, to a maximum rotor diameter of 138m with a maximum turbine tip height of 156m; Adjust the locations of three turbines as follows: T9 moved 6m, T30 moved	Permitted

				16m & T40 moved 16m; Provision of 1.9km of new internal wind farm access roads, localised upgrades to existing access roads. Underground cable route connecting proposed turbines to the Knockranny substation at Letter, on or adjacent to existing wind farm roads. Three new borrow pits located adjacent to proposed T19, T20 and T31 for rock excavation and peat deposition; Extension of two existing / permitted borrow pit for the excavation of rock and the deposition of surplus peat material. All on a site of approximately 76.07ha. Permission was granted by the Planning Authority in March 2020 and granted under appeal to An Bord Pleanála in December 2020.	
Lettercraffroe	SSE Renewables (Ireland) Ltd	8 Constructed	7.3km northwest	**Pl. Ref: 10/1454:** Application by SSE Renewable Ltd to construct a windfarm comprising 8 no. wind turbine and associated infrastructure in Lettercraffoe. Permission was granted by the Planning Authority in December 2010. This wind farm is now operational. **Pl. Ref: 13/375:** Application by SSE Renewables Ltd. for amendments to the permitted substation and access road granted under Pl. Ref 10/1454. Permission was granted by the Planning Authority in July 2013 This wind farm forms part of the Galway Wind Park.	Existing
Knockalough Wind Farm	Knockalough Wind Farm Ltd	11	3km south	**Pl. Ref. 14/1273**: Application by Knockalough Wind Farm Ltd. to construct a wind farm comprising 11 no. turbines and associated infrastructure in the townlands of Knockalough, Finisklin and Laughil. Permission was granted by the Planning Authority on the 5th October 2015. **Pl. Ref. 16/1211**: Application by Knockalough Wind Farm Ltd. for the relocation of one turbine (Turbine no. 4) and associated infrastructure of the previously permitted Knockalough Wind Farm (Pl. Ref. 14/1273) and the provision of additional internal access road. Permission was granted by the Planning Authority in October 2016, and granted following appeal by An Bord Pleanála, under PL07.247605 in October 2017.	Existing
Leitir Gungaid (Lettergunnet)	Coir na Gaoithe Teoranta	10	6.9km south - southeast	**Pl. Ref: 03/4656:** Application for 8 no. turbines in Lettergunnet and Derrycrih granted in May 2004. **Pl. Ref: 09/1326**: Application to amend permission Ref 03/4656 to change the proposed turbine and increase the hub height from 60 metres to 64 metres. Permission was granted by the Planning Authority in August 2009 and granted under appeal to An Bord Pleanála in March 2010. **Pl. Ref: 10/1214**: Application to amend Pl. Ref: 09/1326 to comprise 10 no. wind turbines and changes to associated site layout. Permission was granted by the Planning Authority in March 2011.	Existing

Letterpeck (Shannagurran & Truskaunngappul)	Coir na Gaoithe Teoranta	7	5.3km south	**Pl. Ref: 10/1225**: Application to construct a windfarm comprising of 7 no. wind turbines in Shannagurran and Truskaunnagappul. Granted by the Planning Authority in September 2010 and granted on appeal to An Bord Pleanála in October 2011.	Existing

Table 1.2 Cumulative Impacts – Nearby Wind Energy Projects Considered

Projects	Proximity to Development Lands	Description	Status
Tree Felling - Coilte Owenboliska Sub Catchment / Biodiversity Enhancement Area	27m	Coillte have a felling programme in operation in the area. Based on publicly available information[3], the total area of forestry to be felled over the 9-year period from 2019-2027 is 697.82 hectares, 456.05 hectares of which has already been felled (as at February 2023). Coilte also propose to fell an additional 13.8 hectares of forestry within the Ardderroo Wind Farm boundary as part of a bog restoration plan, subject to licensing.	Ongoing Proposed
Selected Domestic / Agricultural Projects[4] within 2.5km	2.25km south	Planning permission for the erection of dwelling house and garage (Pl. Ref: 211486).	Proposed
	1.5km south	Planning permission for the construction of new storage shed and all associated ancillary concrete works (Pl. Ref: 212041).	Proposed
	1.44km southwest	Planning permission for a dwelling house and garage (Pl. Ref: 211811).	Proposed
	2.3km south	Planning Permission for a domestic shed (Pl. Ref: 181382	Proposed

Table 1.3 Cumulative Impacts – Other Projects Considered

[3] EPA web mapper – gis.epa.ie/EPAMaps and Forestry Licence Viewer – forestry-maps.apps.rhos.agriculture.gov.ie

Ongoing activities in the area that could potentially interact with the proposed project include forestry, peat harvesting, agriculture and operating effluent treatment systems for domestic dwellings. It should be noted that consideration of the above referenced wind projects extends to any associated tree felling activities.

1.10.2. Plans

The zoning and policy objectives for the site are those in the Galway County Development Plan 2022.

1.10.2.1. 2022 Galway County Development Plan

The Galway County Development Plan (CDP) outlines policies and objectives for realising the vision for the County which is:

> *'The promotion of a balanced urban and rural county that ensures future growth is based on the principles of sustainable development, delivering a high-quality living and working environment meeting the needs of all residents'.*

Appendix 1 of the CDP is the County Galway Local Authority Renewable Energy Statement (LARES). The

LARES outlines the renewable energy resource potential in the County and aims to ensure that such developments are suitably located, economical and sustainable in the long term.

Appendix 10 of the CDP contains the Strategic Environmental Assessment (SEA) Statement, the Consolidated Natura Impact Report and Appropriate Assessment (AA) Conclusion Statement. Section 4 of this SEA Statement describes the different development scenarios that were assessed by Galway County Council as part of the preparation of the Development Plan and the SEA process and the reasons for choosing the plan as adopted, in the light of the reasonable alternatives dealt with in accordance with Article 9 of the European Directive (2001/42/EC) on the Assessment of the Effects of Certain Plans and Programmes on the Environment (the SEA Directive).

Four alternative type scenarios were considered during the preparation of the CDP relating to:

- Assessment of Type 1: Alternatives for Positioning under the Settlement Hierarchy;
- Assessment of Type 2: Alternatives for Population Allocations;
- Assessment of Type 3: Alternatives for Rural Areas;
- Assessment of Type 4: Alternatives for Land Use Zoning.

The scenarios look at options for development with preferred scenarios being outlined following the evaluation of the proposed alternative scenarios for their respective impacts on the environment as detailed in Table 4-1 of the SEA Statement.

The potential impact on the environment of the CDP was assessed for cumulative impact and was considered in the preparation of this EIAR, having regard to the Strategic Environmental Objectives (SEOs) detailed in Table 5-1 of the SEA Statement. A review of relevant policy documents is included in Appendix 1-3.

Overall, the Proposed Development has been designed to mitigate impacts on the environment, and a suite of mitigation measures is set out within the EIAR. Additional detail in relation to the potential significant cumulative

[4] Based on a review of Galway County Council's Planning Enquiry system, as accessed on 14th April 2023.

effects arising, and where appropriate, the specific suite of relevant mitigation measures proposed area set out within each of the relevant chapters in the EIAR.

1.11. Difficulties Encountered

No particular difficulties were encountered in compiling any of the specified information contained in this EIAR, such that that the prediction of impacts has not been possible. The relevant chapters of the EIAR, will identify any specific difficulties which may have been encountered during preparation of this EIAR.

1.12. Availability of EIAR Documentation

This EIAR will be available in printed form at the offices of Galway County Council (County Hall, Prospect Hill, Galway).

The EIAR will also be available to view electronically at Galway County Council's online planning application website and on the EIA Portal.

1.13. EIAR Quality Control & Review

HW Planning oversaw the preparation of this EIAR. A key aspect of the EIAR has been to make the documentation as accessible and clear as possible to the public and other relevant stakeholders. This EIAR has been prepared in accordance with the relevant legislation regarding the preparation of as detailed in Section 1.4.

1.14. Typographical Errors

Every effort has been made to ensure that the content and findings of this EIAR is consistent and error free. However, it is acknowledged that some minor grammatical/spelling and typographical errors may occur. These typographical minor inconsistencies are unlikely to result in any material impacts on the overall findings and conclusions of the EIAR.

1.15. References

- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment, (Department of Housing, Local Government and Heritage, August 2018).
- Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, August 2022);
- Environmental Impact Assessment of Projects: Guidance on Scoping (European Commission, 2017);
- Environmental Impact Assessment of Projects: Guidance on the Preparation of the Environmental Impact Assessment Report (European Commission, 2017);
- Advice Notes for Preparing Environmental Impact Statements, Draft, (EPA, September 2015);
- Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment (European Union, 2013).
- Transposition of 2014 EIA Directive (2014/52/EU) in the Land Use Planning and EPA Licensing Systems - Key Issues Consultation Paper, Department of Housing, Planning, Community and Local Government, 2017.
- Circular letter PL 1/2017 - Advice on Administrative Provisions in Advance of Transposition (2017).

CNOC RAITHNÍ (KNOCKRANNY) WIND FARM

CHAPTER 2

Development Description

VOLUME II - EIAR

CHAPTER 2 – Development Description

Contents

Chapter 2

2. DESCRIPTION OF THE PROPOSED DEVELOPMENT

2.1. Introduction

This Chapter of the EIAR provides a description of the Proposed Development. The EIA Directive requires that an EIAR should provide an overview of:

- the location, site, design, size, etc.;
- the physical characteristics of Project (including any demolition or land-use requirements);
- the characteristics of the operational phase of the Project;
- any residues, emissions, or waste expected during either the construction or the operational phase.

As the European Commission's EIAR Guidelines state, the requirement to include a description of the project in the EIA Report is not new, however, the key difference brought about by the 2014 amendments is the inclusion of relevant requisite demolition works during the construction and operational phases. In addition, an estimate of residues and emissions during the construction phase is to be included, where previously such estimates concerned only the operational phase. Article 5 requires other relevant features of the Project to be included. In addition, a description of the location of the Project is now specifically required by Annex IV. Finally, the operational phase of the Project is not limited to production processes, as it was previously.

In addition, the lists of characteristics given in Annex IV, have been expanded upon:

- any requisite demolition works must now be described, where relevant;
- energy demand and energy used should be described in context of the operational phase;
- natural resources must now be described in the context of the operational phase;
- the list of expected residue and emission estimates is no longer exhaustive, and subsoil has been added as type of pollution;
- estimates of quantities and types of waste produced must now be given.

This chapter describes the nature, location and specific characteristics of the proposed development during construction, operational and decommissioning phases in accordance with the 2014 Directive.

2.1.1. Statutory Development Description

Western Power Developments Ltd are seeking planning permission for development in the townlands at Cnoc Raithni (Knockranny), Na hArd-Doiriú (Ardderroo) and Leitir (Letter), Moycullen, Co. Galway. The development will consist of the following:

1) Alterations to the Cnoc Raithni (Knockranny) Wind Farm (Galway County Council Planning Ref. No. 13/829 and An Bord Pleanála Ref: 07.243094) comprising 11 no. wind turbines with an overall ground to blade tip height of 150m (an increase of 19.5m & 9.5m from 130.5m & 140.5m, as previously permitted), a rotor blade length of 68m or 69m and a hub height of 81m or 82m; associated increase in turbine foundations; and omission of permitted on-site 110kV substation and underground cabling;
2) Provision of underground electrical (33kV) and communications cabling connecting the 11 no. wind turbines to the Ardderroo wind farm substation for the purposes of connection to the national grid, including a new cable service track (with watercourse/culvert crossings) and widening of an existing access road; extension of the Ardderroo substation within the existing substation compound, including control building extension, new 110kV transformer and electrical plant & apparatus;
3) All associated site development and ancillary works above and below ground in support of the above, including site drainage and tree felling;
4) An operational period and planning permission duration to align with the existing permission (An Bord Pleanála Ref: 07.243094) is sought.

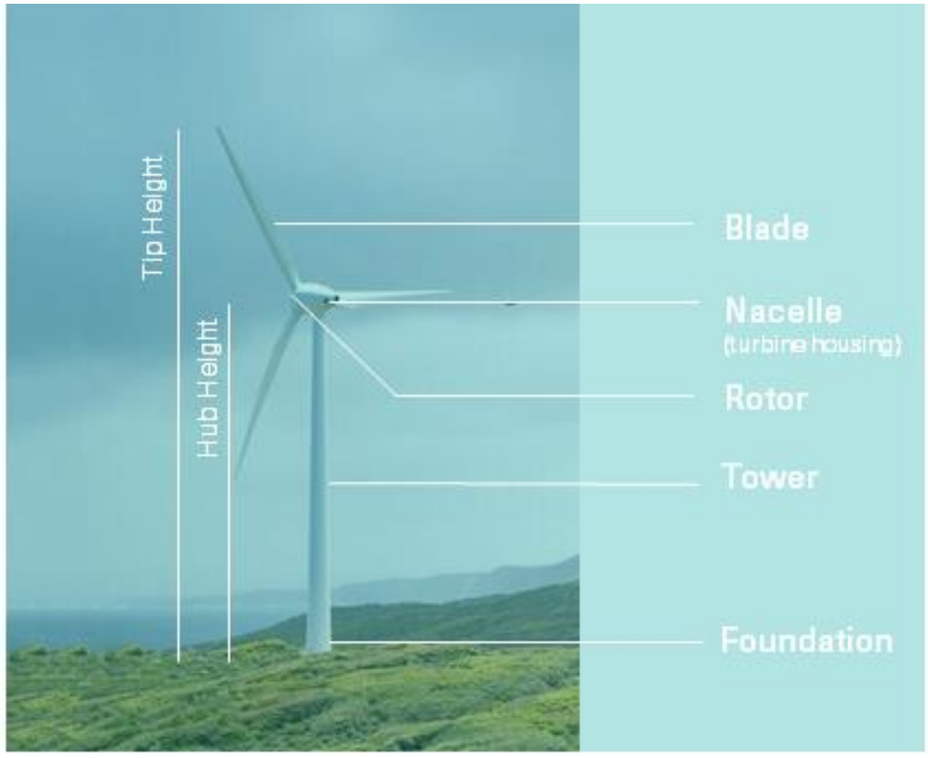

Figure 2.1 Turbine Components

TURBINE COMPONENTS

A wind turbine, as shown in Figure 2.1 consists of four main components:

- Foundations,
- Tower,
- Nacelle (turbine housing),
- Rotor.

FOUNDATIONS

Reinforced concrete foundations are installed for each wind turbine below the finished ground level. The size of the required foundations varies by turbine type. The shapes also range from circular to hexagonal and square, depending on the requirements of the turbine supplier. The turbine foundation transmits any load on the wind turbine into the ground. After the foundation level is formed using piling methods, the bottom section of the turbine tower "Anchor Cage" is levelled and reinforcing steel is then built up around and through the anchor cage. The outside of the foundation is shuttered with demountable formwork to allow the pouring of concrete and is backfilled accordingly with appropriate granular fill to finished surface level (ref Figure 2.2).

Figure 2.2 Sample Image of Turbine Foundation Anchor Cage

HARD STANDING AND ASSEMBLY AREA

Figure 2.3 Sample Image of Turbine Hard Standing Area

Once the turbine foundation is in place the hard-standing area is extended to cover the turbine foundations. The hard standing area comprises levelled and compacted hardcore to facilitate access, turbine assembly and turbine erection. Typically these areas accommodate cranes used in the assembly and erection of the turbine, offloading and storage of turbine components. As with the foundations the sizes, arrangement and positioning of hard standing areas are generally dictated by turbine suppliers.

As can be seen in Figure 2.3 levelled assembly areas are also required beside the hard standing area for offloading turbine blades, tower sections and other components until they are ready to be lifted into position by the crane.

TOWER

The tower of the wind turbine supports the structure of the turbine including the nacelle and the rotor. They usually come in three sections and are assembled on site. Because wind speeds increase with height, taller towers enable turbines to capture more energy and generate more electricity. Towers for large wind turbines may be either tubular steel towers or concrete towers.

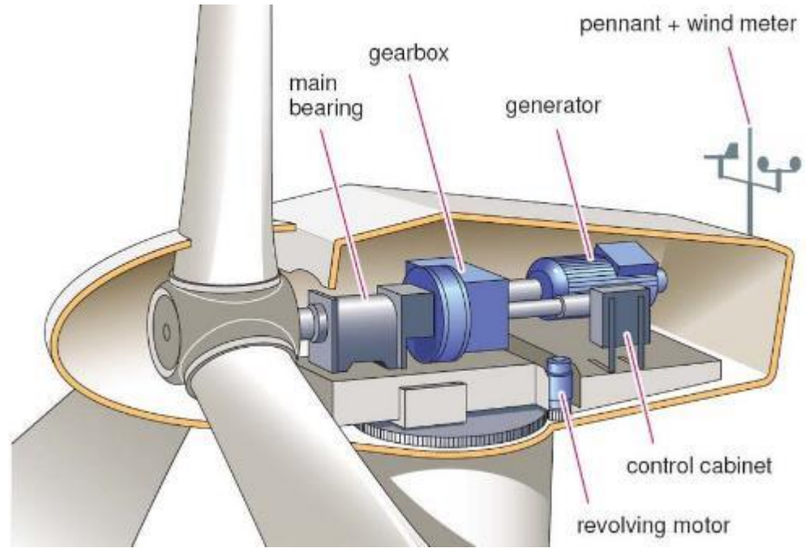

Figure 2.4 Cross-section of a Nacelle

NACELLE (TURBINE HOUSING)

The nacelle is located at the top of the tower and contains the gearbox, low- and high-speed shafts, generator, and brake.

ROTOR - HUB AND BLADES

The rotor is the rotating part of the turbine; it consists of the blades and the hub, a central part connecting the blades. When wind flows across the blade, the air pressure on one side of the blade decreases. The difference in air pressure across the two sides of the blade creates both lift and drag. The force of the lift is stronger than the drag and this causes the rotor to spin. Most turbines have three blades which are generally fibreglass. Turbine blades vary in size, with typically offshore turbines having longer blade lengths. There are currently prototypes for offshore turbines blades of between 115m and 123m in length. The turbines in the adjacent Ardderroo Wind Farm, which is under construction, are amongst the taller turbines in Ireland, with a blade length of c. 75m, and an overall tip height of c. 178m.

Figure 2.5 Rotor Diameter

ROTOR DIAMETER

The rotor diameter is the cross sectional dimension of the circle swept by the rotating blades of a turbine. It equates to two blade lengths (Ref. Figure 2.5).

HUB HEIGHT

A wind turbine's hub height is the distance from the ground to the middle of the turbine's rotor (ref. Figure 2.1).

TIP HEIGHT

A wind turbine's tip height is the distance from the ground to the top of the turbine blade at its highest point. This equates to the sum of the hub height and the blade length.

2.2. The Permitted Development

The Permitted Development (Planning Ref. No. 13/829 and ABP Ref: 07.243094) consists of 11 No. Wind Turbines (blade tip height up to 140.5m and 130.5m) with hardstands/ foundations, 110kV substation, and associated infrastructure and works (ref. Figure 2.6).

2.3. The Proposed Development

The Proposed Development will consist of:

- Alterations to the turbine dimensions;
- Associated increase in turbine foundations;
- The omission of the previously approved on-site 110kV substation and underground cabling;
- Provision of underground electrical (33kV) and communications cabling connecting the 11 no. wind turbines to the Ardderroo wind farm substation;
- Associated road widening and new cable service track and watercourse/culvert crossings;
- Extension of the Ardderroo substation within the existing substation compound, including IPP control building extension (c.75 m2), new 110kV transformer and electrical plant and apparatus.
- Provision of site drainage works in support of the Proposed Development;
- Tree felling in support of the Proposed Development.

2.3.1. Turbine Modifications

Significant progress has been made in wind turbine technology since the original layout design in 2013.

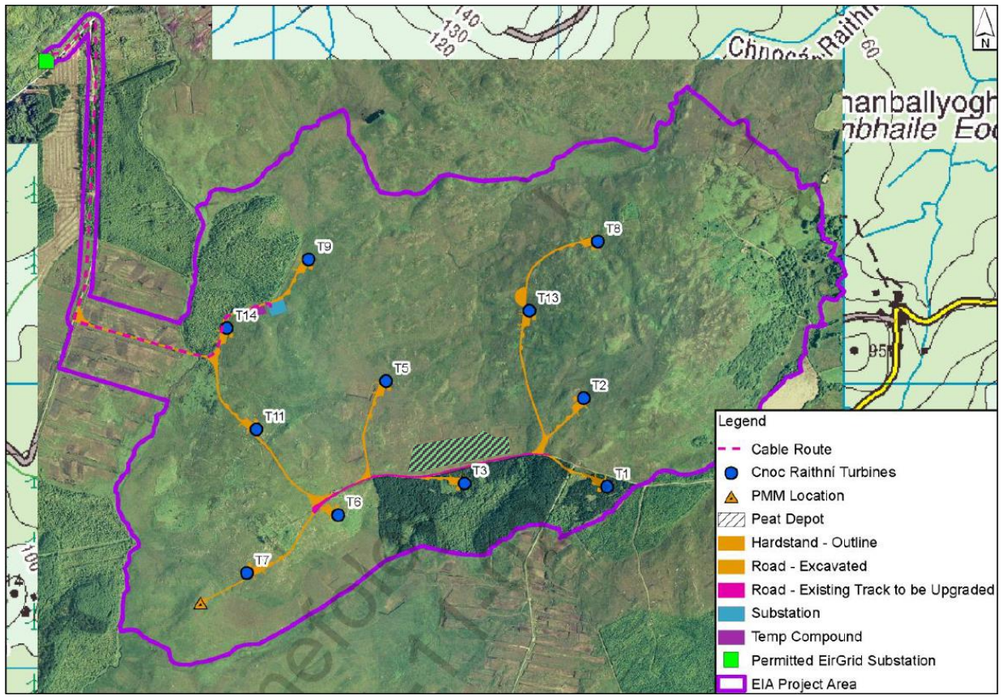

Figure 2.6 Permitted Development Site Layout and EIS Boundary (extracted from Fig 2.4 EIS Prepared by Malachy Walsh & Partners 2013)

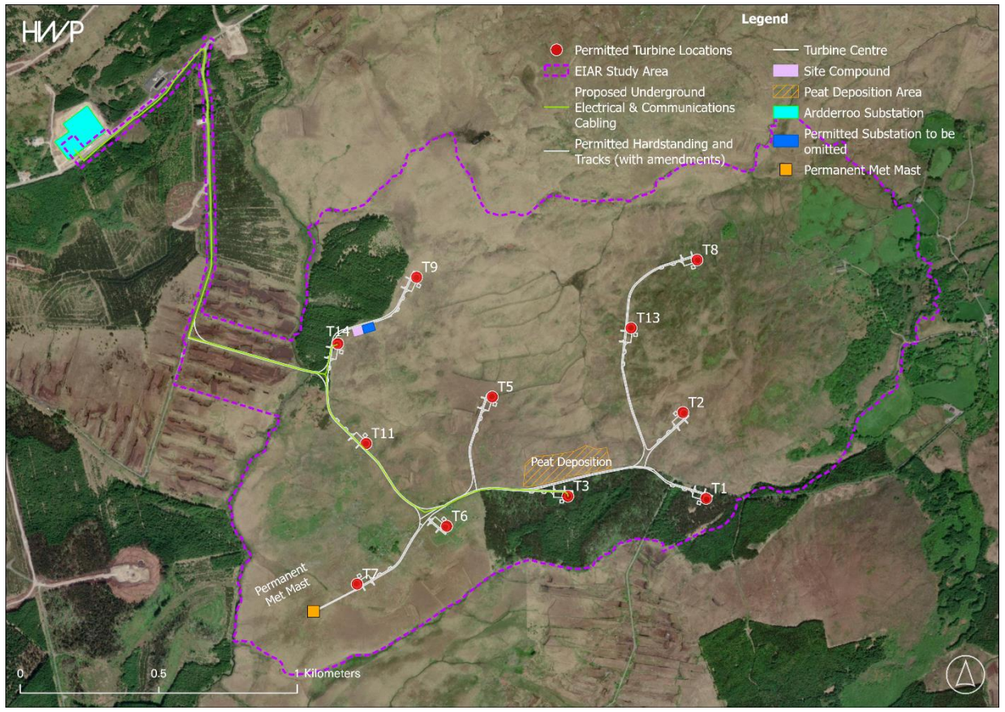

Figure 2.7 Details from Proposed Amended Layout and Revised EIAR Boundary

While the turbine number and locations are being maintained, as outlined in Figures 2.6 and 2.7, the proposed tip heights of 130.5m and 140.5 m has been reconsidered in view of these developments, with a standard tip height of 150m now being proposed. The proposed change in turbine dimensions will necessitate revisions to the supporting foundation. However, while in the original permitted layout 6 no. turbines had a hub height of 90m and 5 no. turbines had a hub height of 80m, it is now proposed that all turbines will have a hub height of 81m or 82m. Two candidate turbine types are being considered:

Candidate Turbine	Rotor Diameter (m)	Tip Height (m)	Hub Height (m)
Vestas V136	136	150	82
Enercon 138	138	150	81

Table 2.1 Candidate Turbine Specification for Proposed Development

The proposed increase in overall turbine height to 150m will result in enhanced efficiency and an increased energy generating potential of between 13.86MW and 16.5MW installed capacity[1]. The individual turbine details are outlined in Table 2.2.

Turbine ID			Permitted		Proposed	
	X-Coord	Y-Coord	Hub Height	Tip Height	Hub Height	Tip Height
Turbine 1	516137	733670	80	130.5	81 or 82	150
Turbine 2	516053	733980	80	130.5	81 or 82	150
Turbine 3	515637	733678	80	130.5	81 or 82	150
Turbine 5	515363	734036	90	140.5	81 or 82	150
Turbine 6	515199	733570	90	140.5	81 or 82	150
Turbine 7	514875	733361	90	140.5	81 or 82	150
Turbine 8	516103	734530	80	130.5	81 or 82	150
Turbine 9	515090	734468	90	140.5	81 or 82	150
Turbine 11	514908	733868	90	140.5	81 or 82	150
Turbine 13	515865	734285	80	130.5	81 or 82	150
Turbine 14	514806	734228	90	140.5	81 or 82	150

Table 2.2 Individual Turbine Dimensions

[1] Estimated generating capacity of E138 = 4.26MW and V136 = 4.5MW

Such dimensions may change as a balance is reached in procuring a final turbine selection under the design envelope of candidate turbines with a rotor blade length of 68 or 69m and a hub height of 81m and 82m and tip height of up to 150m. Chapter 3 – Alternatives sets out the rationale for the turbine modifications.

2.3.2. Power Output

Based on the output of the two candidate turbines, it is anticipated the proposed wind turbines will have a rated electrical power output in the 4.26 to 4.5 megawatt (MW) range depending on further wind data analysis and power output modelling. This equates to an estimated installed capacity, for the proposed 11-turbine wind farm, of between 46.86MW and 49.5MW per hour. The Proposed Development, therefore, has the potential to produce between 13.86MW and 16.5 MW more output per hour than the Permitted Development which had an estimated maximum output of 33MW.

Assuming an installed capacity of 46.86 MW, the Proposed Development therefore has the potential to produce up to 143,672 MWh (megawatt hours) of electricity per year, based on the following calculation.

A x B x C = Megawatt Hours of electricity produced per year

where:

- A = The number of hours in a year: 8,760 hours.
- B = The capacity factor, which takes into account the intermittent nature of the wind, the availability of wind turbines and array losses etc. A capacity factor of 35% is applied here.
- C = Rated output of the wind farm: 46.86 MW.

Assuming an average Irish household usage rate of 4.2 MWh of electricity this equates to the supply for 34,208 households per annum, equivalent to 19% of the households in County Galway (based on 2016 Census figures), which is 5.5% more than the Permitted Development.

If an installed capacity of 49.5 MW is considered, the Proposed Development has the potential to generate 151,767 MWh of electricity per year, equating to the electricity usage of an 20% of the County Galway households per annum, and 6.5% more than the Permitted Development.

	Permitted	E138	V136
Installed capacity (MW)	33	46.86 (13.86 more than permitted)	49.5 (16.5 more than permitted)
Potential MWh of electricity produced per year	101,178	143,672	151,767
Number of Households Supplied	24,090	34,208	36135
% 2016 Population of Galway County Supplied	13.5%	19%	20%

Table 2.3 Electricity Output Estimates

2.3.3. Turbine Foundations and Hardstands

As the turbine locations remain unchanged from the Permitted Development, the location and area of the hardstandings are not being altered as part of the Proposed Development. However, as a result of the increased heights and larger rotor and different candidate turbines, modification to the turbine foundations are proposed. The foundations that were considered in the EIS for the Permitted Development were a 15.5m x 15.5m square form with a depth of 4.35m. The proposed foundations are circular with a 24m diameter and a depth of 3.4m. Further detail on the result of the additional foundation footprint can be found in Chapter 7: Land and Soils.

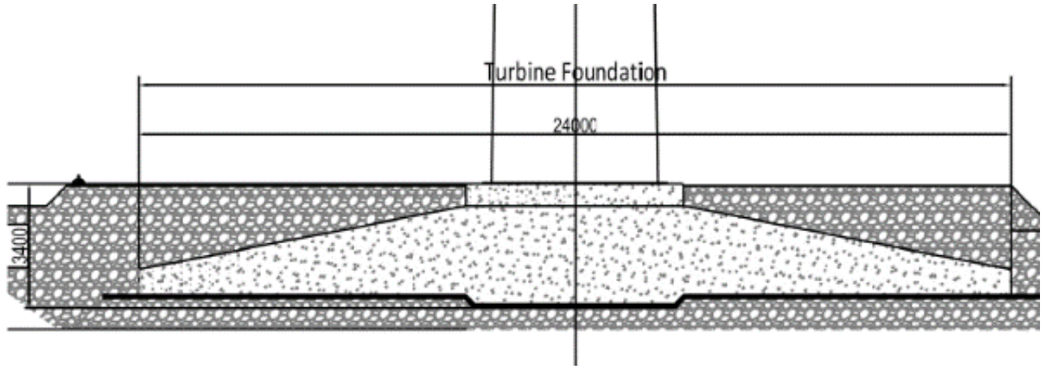

Figure 2.8 Proposed Turbine Foundations

2.3.4. Omission of On-Site Substation

In the context of recent infrastructural changes in the local environment, the proposed amendments include the omission of the previously permitted 110kV substation on-site, with an area of 2,771m^2. This will result in a significant reduction to the hardstanding area of the wind farm footprint. Chapter 3 – Alternatives details the applicant's rationale for the omission of this substation.

2.3.5. Connection to the Ardderroo Substation

The Permitted Development included an assessment of the envisaged grid connection in the previous EIS which comprised a 2km long 110kv underground cabling route that was located within the wind farm internal road and along the existing forest and wind farm access roads. As noted above, recent infrastructural changes in the vicinity, in the form of the development of the Ardderroo Substation, have precipitated a change in the grid connection strategy, consent for which is now being sought.

The alternate design provides for alteration to the 110kV cabling trench to accommodate a double 33kV cabling circuit and the extension of the originally envisaged cabling route by c. 500m west of the Knockranny substation to the Ardderroo substation and comprises:

- The amalgamated power from the 11 no. wind turbines will be connected to the Ardderroo Substation with 2 no electrical circuits, currently indicated to commence at turbines T3 and T14.
- Circuit 1 will run from T3 for c.1,190m where it meets Circuit 2 at the Permitted Development site entrance road T-junction, Circuit 2 will run from T14 to the T-junction for c. 125m, from here the combined double circuit will run along the wind farm entrance road for c.510m;
- From the wind farm entrance road, the proposed cabling route will travel north accommodated within an existing road to be widened for c.570m, and will continue north within the existing Ardderroo wind farm road for a further c.480m, before turning west towards the Ardderroo substation.
- This proposed cabling route will turn west running parallel to the existing road that accesses the Ardderroo substation, running within a new cable service track to the south of the existing road for c.590m, before turning north under the existing access road and connecting to the proposed control building extension at the Ardderroo substation compound (c.50m).

Figure 2.9 Proposed Cabling Route Northern Section

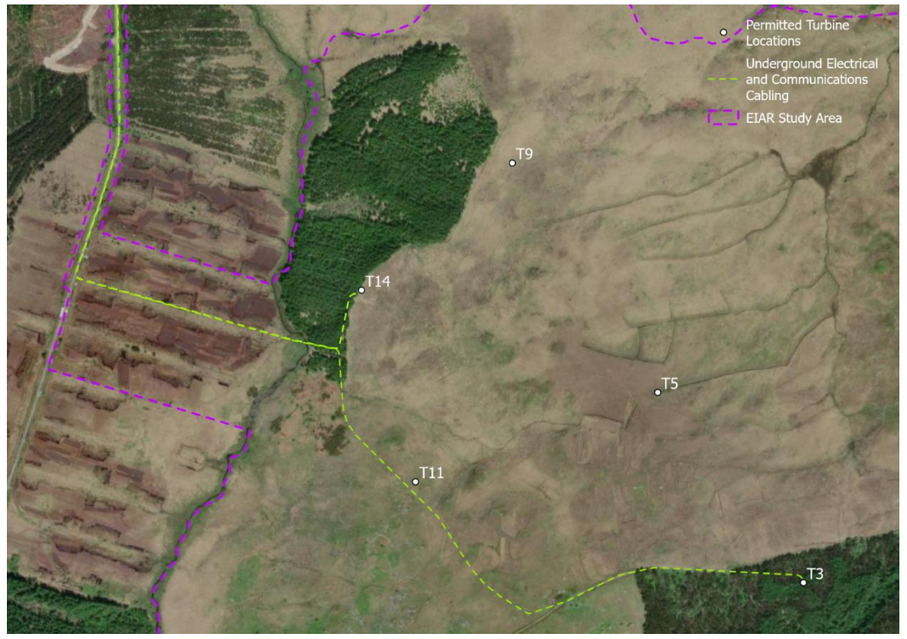

Figure 2.10 Proposed Cabling Route Southern Section

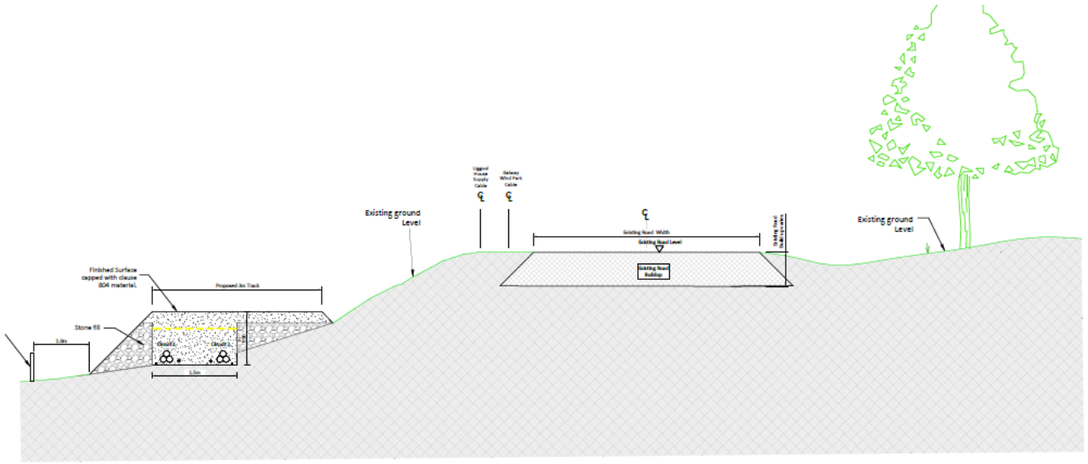

Figure 2.11 Indicative Cross-section through Cabling Service Track

Figure 2.12 Typical Cable Trench (Extracted from CEMP)

The underground cabling trench will consist of the top layer of soil being removed and saved locally for replacement on completion, where relevant. The cables will be bedded with suitable material and the 33kV cable circuits will include power ducts, communication fibre duct and earth wire (ref. Figure 2.12).

The remainder of the trench will be backfilled in two compacted layers with approved engineer's specified material. The finished surface will be reinstated, as per original specification. Off-road cabling will be finished with granular fill (CL.804 or equivalent) to facilitate access to the trench for any potential maintenance that is required during the operational phase of the Proposed Development. Marker posts will then be placed at regular intervals (generally at joint bays and any change in direction) to denote the location of the underground power cables.

A detail of the cables crossing in front of the Ardderroo Substation is provided in Figure 2.13 and 2.14 below.

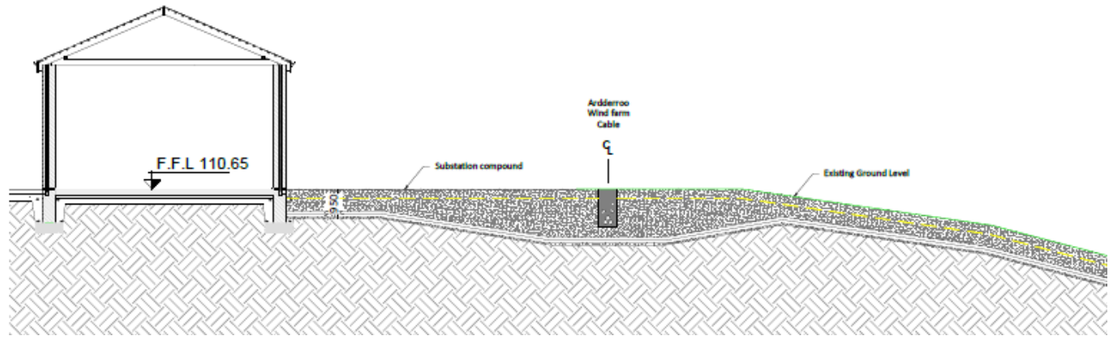

Figure 2.13 Crossing to Ardderroo Substation (a)

This detail indicates the cables traversing the road, under the Galway Wind Park, Uggool House Supply and Knockalough Wind Farm cables. As it approaches the substation it passes under the Ardderroo Wind Farm cable and enters the substation.

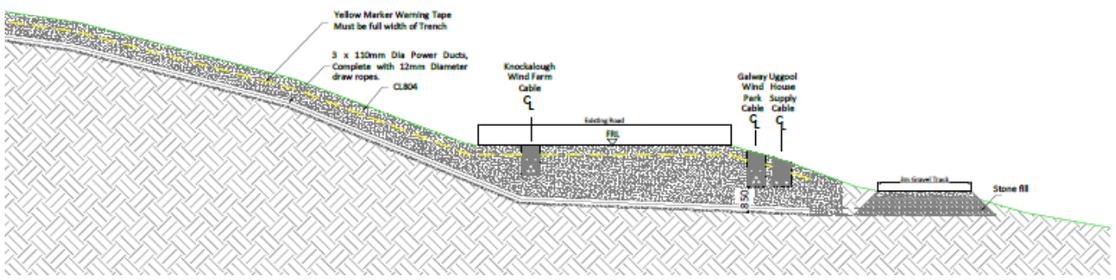

Figure 2.14 Crossing to Ardderroo Substation (b)

2.3.6. Ardderroo Substation Extension

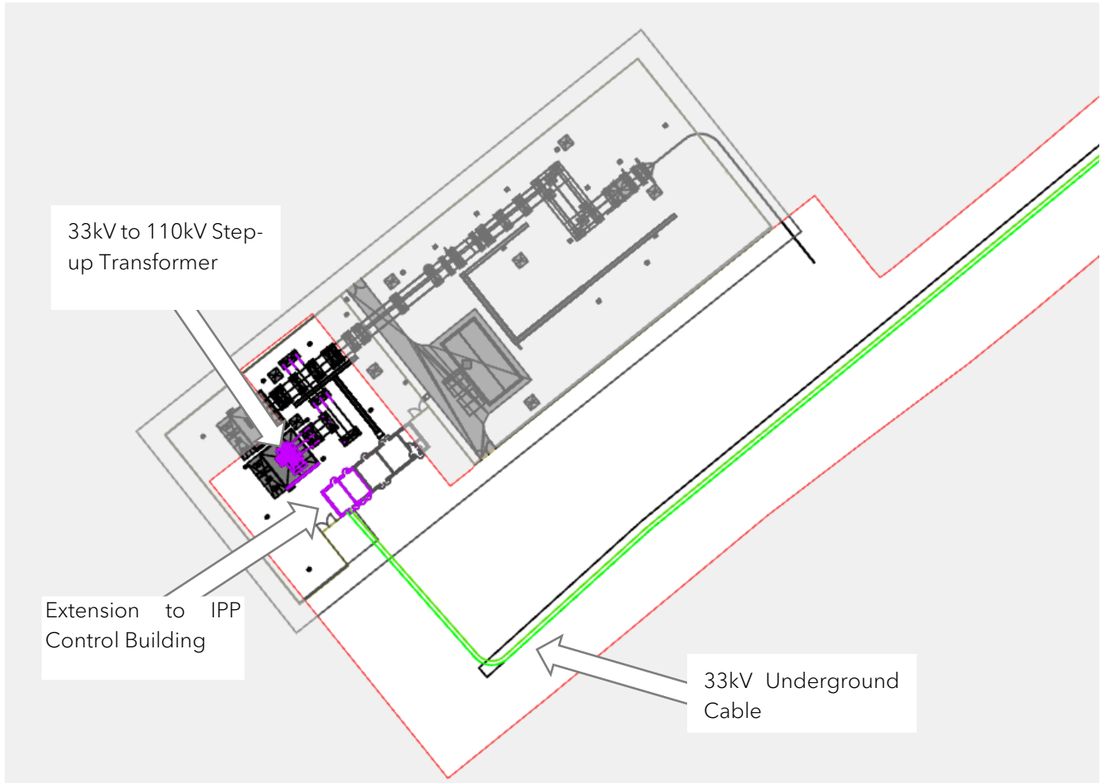

Figure 2.15 Proposed Connection to Ardderroo Substation

The proposed Ardderroo substation Extension will include:

- An extension to the control building, (c.75 m2)
- A 110kV transformer and bunded concrete plinth,
- All associated electrical plant and apparatus.

Figure 2.15 outlines these amendments in detail.

2.3.7. Culvert Crossing/Amendments to Existing Roadside Artificial Drainage Measures

As outlined in Figure 2.16, there are 8 no. proposed culvert crossing points along the proposed underground cabling route, with pipe sizes ranging from 450mm to 600mm. In the case of crossing points 1 – 5, the cabling runs parallel and offset from the road with the proposed culverts comprised of extensions to the existing pipe running under the road (ref Figures 2.17). Crossing 5 is a culverted watercourse crossing, all other crossings are existing artificial drain crossings. In relation to culverts 6 – 8, the cabling will be laid within the existing road over the existing culverts.

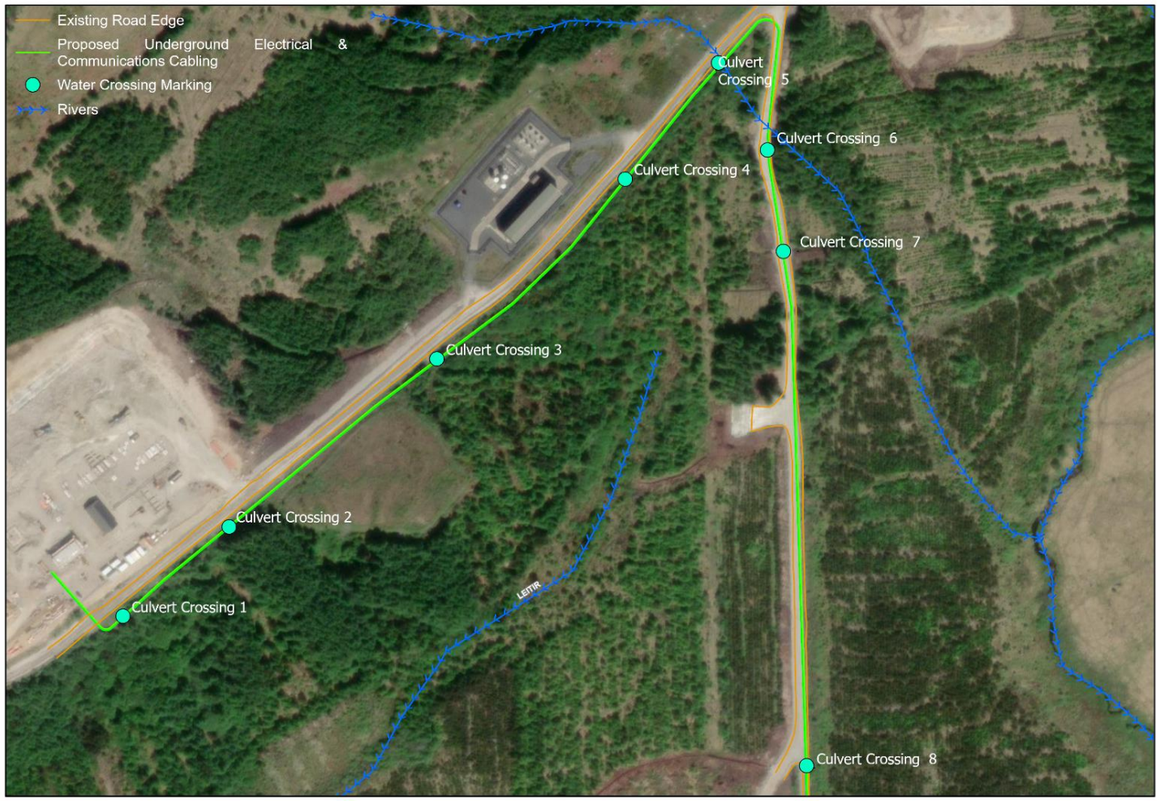

Figure 2.16 Culvert Crossings

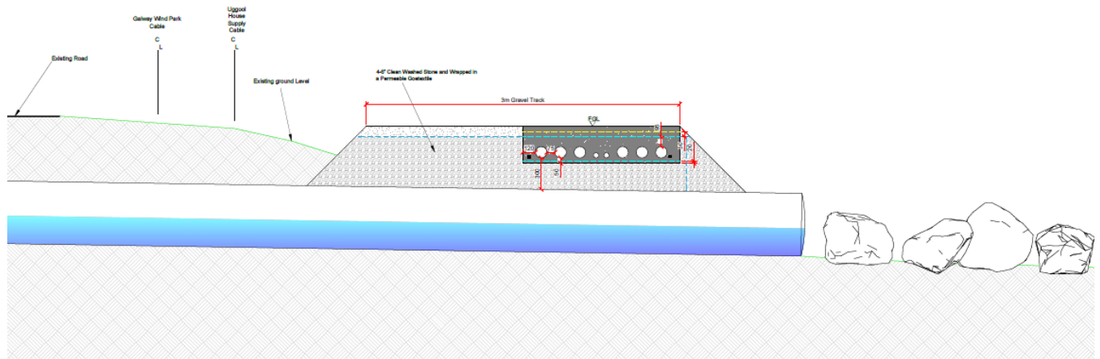

Figure 2.17 Culvert Crossing with Erosion Control

There are existing drainage measures located south of the road serving the Ardderroo substation. These will be relocated to the south of the proposed new cable service track. To ensure that the proposed cable track does not impede any existing surface water runoff from the existing road, the design makes provision for a piped channel under the track to convey runoff to the relocated drainage measures (ref. Figure 2.18). The proposed access track

will be built up with porous 4-6" clean washed stone and wrapped in a permeable geotextile. This will allow surface water to filter beneath the access track and prevent any ponding occurring between the roads.

Erosion control measures will be deployed at the outlet of extended culverts in the form of placed stone boulders to reduce and dissipate water flows (ref. Figure 2.17).

Over-the-edge drainage measures will apply in the case of the widening of the existing road, supplemented by silt fencing on the lower side to treat any 'dirty runoff' before discharge to ground (refer to Drainage Layout Drawings prepared by Malachy Walsh and Partners, that accompany this application).

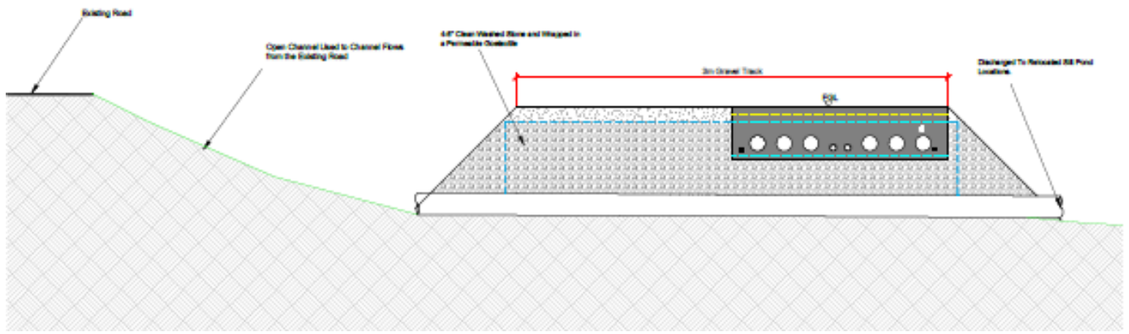

Figure 2.18 Runoff from Existing Road Collected and Conveyed to Relocated Silt Pond

2.3.8. Tree Felling and Hedgerow Removal

The standard mitigation for bats requires a 50m buffer distance between the turbine blade tip and the nearest woodland. As the Proposed Development includes an increase to the turbine blade length, there is a requirement for a slight increase in tree-felling around permitted turbines 1, 3, 9 and 14 to accommodate this ecology requirement. This equates to 2.437 hectares of additional tree felling for the Proposed Development.

In addition, there is a small area of woodland across from the Ardderroo Substation that could potentially be impacted. This is calculated to be 0.016 hectares in area. It is likely that trimming back of some above ground parts of trees will be required rather than felling at this location. However, it is included in the felling figure for completeness. Overall, it is anticipated that an area of 2.45 hectares of trees may require felling. Further details on felling and brashing is provided in Chapter 9 – Biodiversity.

In line with the Forest Service's published policy on granting felling licences for wind farm developments, areas cleared of forestry for access roads, and any other wind farm-related uses will have to be replaced by replanting at an alternative site or sites. The estimated 2.45 hectares that will be permanently felled for the footprint of the Proposed Development infrastructure will be replaced or replanted on a hectare for hectare basis as a condition of any felling licence that will be issued in respect of the Proposed Development. Replanting is a requirement of the Forestry Act and is primarily a matter for the statutory licensing processes that are under the control of the Forest service. The replacement of forestry, felled as part of the Proposed Development, may occur on any lands, within the state, benefitting from Forest Service Technical Approval for afforestation, should the Proposed Development receive planning permission. This will take place outside the subject water catchment. Under the Forestry Regulations 2017, all applications for licences for afforestation require the prior written approval (technical approval) of the Minister for Agriculture, Food and the Marine. Before the Minister can grant approval, he/she must first determine if the project is likely to have significant effects on the environment (for EIA purposes) and assess if the development, individually or in combination with other plans or projects is likely to have a significant effect on a European site (for Habitats purposes).

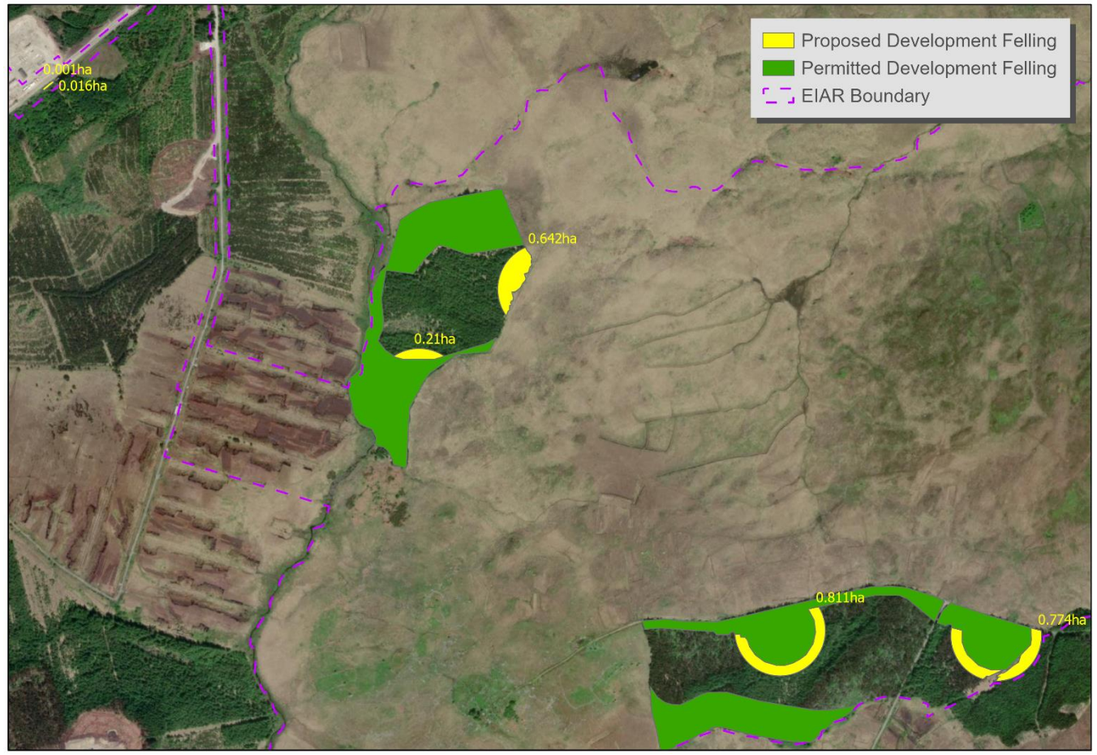

Figure 2.19 Tree Felling

2.3.9. Spoil Management – Excavated Peat and Subsoil

As with the Permitted Development no excavated soils, subsoils, or bedrock will require disposal outside the boundaries of the proposed development lands. With the exception of peat soils, excavated materials from all construction activities will be stockpiled at hardstand locations during construction and subsequently reused on site for regrading or revegetation.

Excavated peat soils, will be segregated and placed within the permitted peat storage/deposition area located within the site boundary. The location of the peat storage/deposition area is due north of T3 to the south of the site.

The peat storage area is an existing area of cutover bog and has been chosen for its low peat instability risk, low lying recessed area of ground, and suitable topography. The area will require preparation which includes the construction of natural stone berms to manage the location of peat within the cutover area. The Proposed Development will result in an additional 12,900 m3 of peat and it has been demonstrated that the permitted peat deposition area can accommodate same. This is discussed in detail in Chapter 7 of this EIAR.

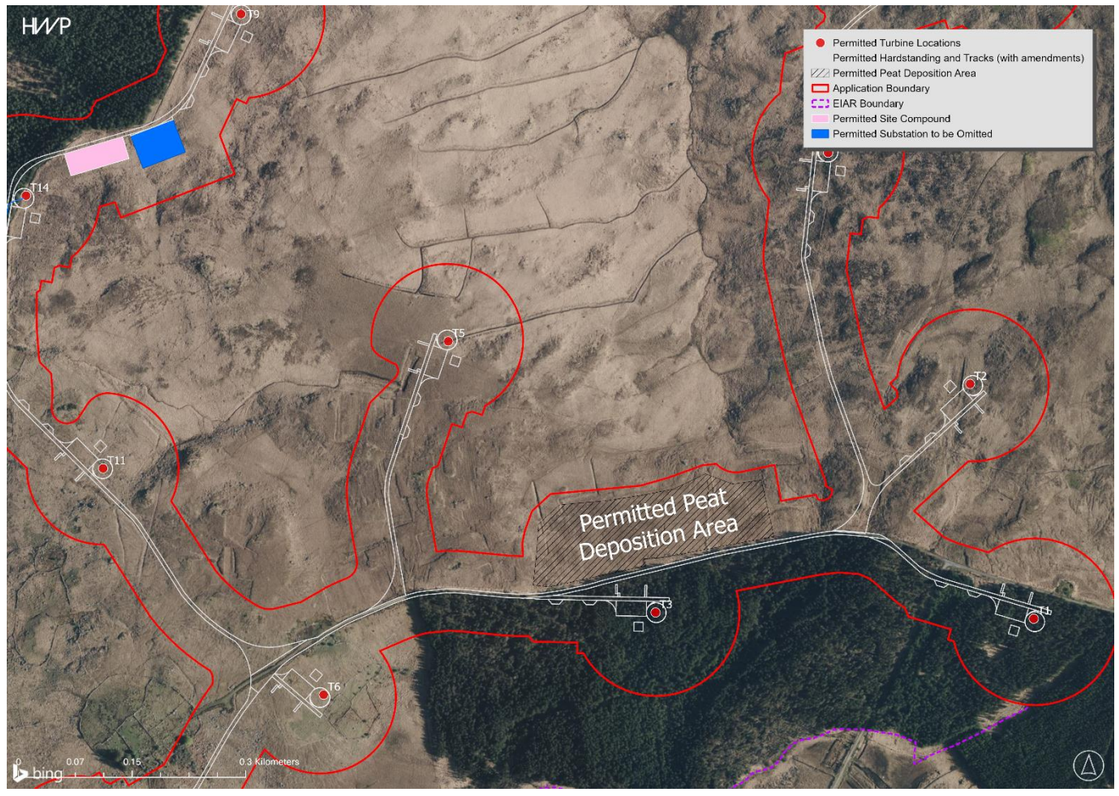

Figure 2.20 Permitted Peat Deposition Area

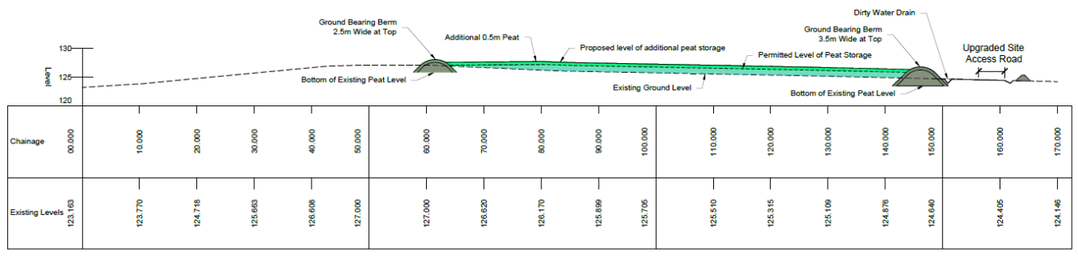

Figure 2.21 Sample Section of Permitted Peat Deposition Area with Additional Peat Storage

2.3.10. Turbine Delivery

The turbine delivery route remains largely unchanged from that of the Permitted Development, with the exception that the turbines will now be delivered from Galway Port as opposed to from Foynes. The proposed route was recently utilised for the delivery of the adjacent Ardderroo Wind Farm turbines.

The route incorporates:

- The N59 national road from Galway City
- The L53453
- Forestry Road

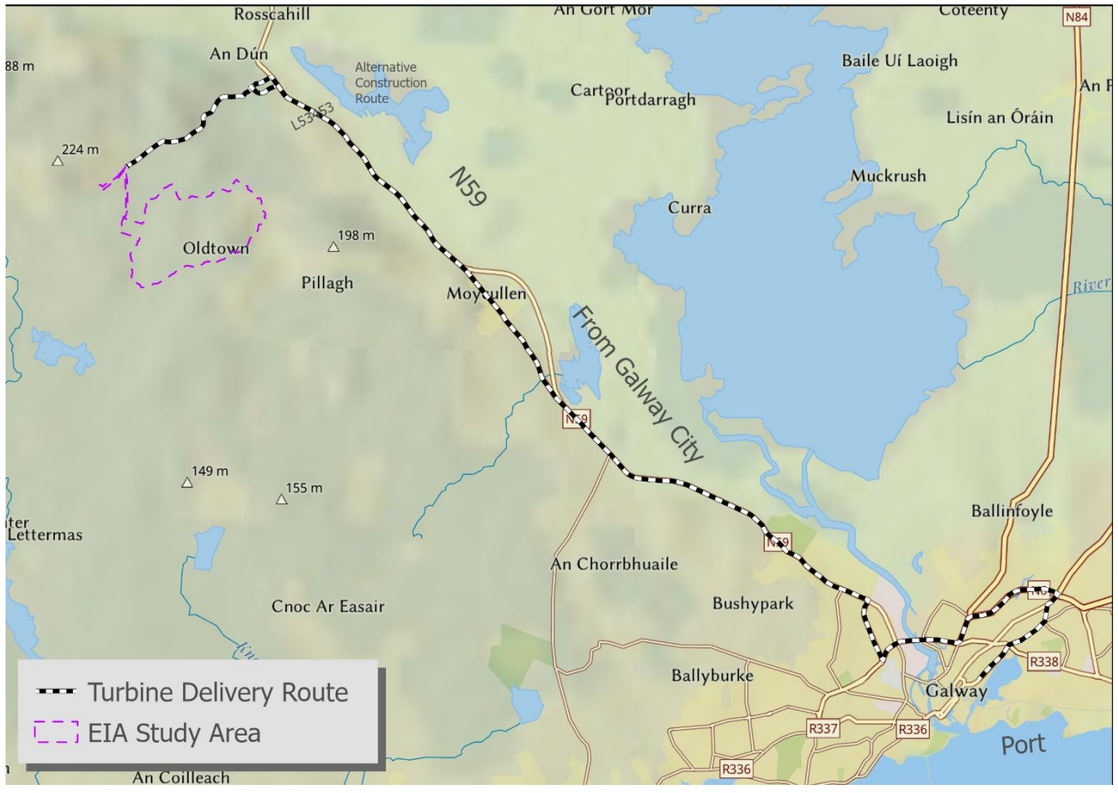

Figure 2.22 Turbine Delivery Route

The route is outlined in Figure 2.22. Chapter 5 of this EIAR contains a detailed assessment of the route.

2.3.11. Sequencing / Delivery Programme/ Working Hours

It is the Applicants intention to apply for planning permission of a duration that aligns with that of the Permitted Development. This will enable concurrent construction of the Proposed Development and the Permitted Development.

The Permitted Development programme of works outlined that the estimated total project duration would be of the order of 16-18 months. In the previous EIS it was envisaged that the delivery of the Permitted Development, including grid connection and underground cabling, would take this duration. It noted however that this was

dependent on how effectively the works are scheduled to coincide with each other and relates directly to existing environmental and user constraints. It is expected that the Proposed Development will not significantly alter the original project programme, with the construction works carried out in the following phased manner:

- As the internal site access roads are constructed up to each turbine, hardstanding areas for the crane, turbine foundations and building foundations will be prepared.
- Once the roads are completed, the trenching and laying of underground cabling adjacent to the roads will begin.
- Construction of the extension to the Ardderroo sub-station and control building will commence so that they will be ready to export power as turbines are commissioned.

The development sequencing (ref. Table 2.4) as set out in the previous EIS is considered to remain applicable for the Proposed Development. Some identified activities will overlap or be undertaken concurrently.

Phase	Activity	Duration
Phase 1	Prepare site, Pre-construction activities, Site entrance, temporary compound and clearfelling	2 months
Phase 2	Access road construction + Drainage plan implementation	3 months
Phase 3	Hard standing construction for turbines	2 months
Phase 4	Turbine Foundation construction	4 months
Phase 5	Trenching and ducting	2 months
Phase 5A	Grid connection underground cabling route	2/3 weeks
Phase 6	Substation construction	4 months
Phase 7	Permanent meteorological mast erection	1 month
Phase 8	Turbine delivery	4 months
Phase 9	Turbine erection	4 months
Phase 10	Wind Farm Commissioning	4 months

Table 2.4 Development Sequencing

The site working hours are expected to be 07:00 to 19:00 Monday to Saturdays with no site work generally on Sundays and bank holidays, except in circumstances where contractors see suitable weather windows outside of these times for the construction of the wind turbines. Material deliveries may be taken outside these times on certain occasions.

Work outside these hours is not usual, though if it was required to meet specific short-term demands, the Local Authority would be informed, as required.

2.3.12. Temporary Facilities

The Permitted Development's Temporary facilities will be used during the construction of the Proposed Development. Following completion of the Development, all construction facilities will be removed and the area returned to its original use.

2.4. Construction Phase

2.4.1. General Construction Methodology

The Proposed Development will be constructed in accordance with documented ISO 14001 (2015)[2] environmental management procedures to ensure compliance with applicable environmental legislation and best practice. Effective communication underpins the whole system of environmental management, ensuring appropriate information passes between the Applicant and the consultants / contractors engaged. This ensures that environmental considerations are fully integrated into the management of the development throughout construction, the operation, and maintenance of the completed project and ultimately to decommissioning.

2.4.2. Construction Environment Management Plan

Standard construction working practices will be implemented during construction and any maintenance works, in order to ensure adherence to relevant guidance and other current best practice. The construction of the Proposed Development will occur as part of the wider construction of the Permitted Development. A Construction Environmental Management Plan (CEMP) has been prepared for the Project, inclusive of Permitted and Proposed Developments which will be implemented in full during the construction stage.

Prior to the commencement of construction works, the Applicant will submit to the planning authority a Traffic Management Plan (TMP). The delivery route for abnormal loads and general traffic is established based on the Permitted Development. A Framework TMP has been provided in the CEMP.

The Applicant will retain the services of specialist advisers, for example on archaeology, ecology, and peat restoration, to be called on, as required, to advise on specific issues, as identified in the relevant technical sections, where appropriate.

The CEMP sets out how the Project would be constructed and the mitigation commitments as included in the chapters of this EIAR and the EIS for the Permitted Development. These commitments include both specific mitigation measures as well as proposals for monitoring and emergency procedures. Such emergency procedures include a site-specific Pollution Incident Response Plan in order to prevent and mitigate damage to the environment caused by accidents such as spillages and fires.

The CEMP (Appendix 2.1) has been produced to capture a diverse range of environmental management controls. Key measures incorporated into the CEMP include:

- an overview of construction methodologies that will be adopted throughout the project.
- details of the environmental controls on site which looks at noise and dust controls. Site drainage measures, peat stability monitoring measures and a waste management plan are also included.
- The drainage design as presented in the EIAR and Planning Application documents which includes principles of silt management and pollution prevention and will inform the detailed drainage design for the permitted wind farm which will be prepared prior to the commencement of development.
- a fully detailed implementation plan for the environmental management of the project outlining the roles and responsibilities of the project team.
- the water monitoring programme for the various phases of the project.
- an overview of the environmental training that will be provided to site personnel.
- the Emergency Response Plan to be adopted in the event of an emergency in terms of site health and safety and environmental protection.
- all mitigation proposals to be adhered to during the project, categorised into three separate headings, 1) pre-commencement measures; 2) construction-phase measures and 3) operational-phase measures.
- all monitoring requirements and proposals to be adhered to during the project, categorised into three separate headings, 1) pre-commencement measures; 2) construction-phase measures and 3) operational-phase measures.
- programme for the timing of the works.
- the proposals for reviewing compliance with the provisions of the CEMP.

The CEMP requires pre-commencement agreement with the appropriate planning authorities and bodies, prior to construction. In order to ensure that the CEMP is being suitably adhered to by the appointed contractors, a qualified Environmental Clerk of Works (ECoW) would be employed during the construction phase of the project to monitor implementation of the CEMP and provide specialist advice. The ECoW would liaise with the various environmental, archaeological and other advisers who would have input into the project to ensure compliance is met in relation to any imposed planning conditions as well as the approved CEMP.

2.5. Operational Phase

It is considered that the operational effects of the Proposed Development will not be altered from those of the Permitted Development as outlined in the EIS.

2.5.1. Commissioning

As outlined in the EIS wind farm commissioning can take 4-6 months to complete after the erection of the final turbine. It involves commissioning engineers working through an entire schedule of SCADA (Supervisory Control and Data Acquisition) and electrical testing and control measures to ensure the wind farm will perform and export power to the national grid, as designed.

As the EIS noted all turbines have to be checked, commissioned and powered up for testing and final sign off. All underground electrical cabling and SCADA network cabling is also checked and tested. The connection to the Ardderroo substation facility in addition has to be tested. At the end of the commissioning stage the wind farm is then fully operational and exporting power onto the national grid via the underground grid connection route.

2.5.2. Turbine Maintenance

In line with the EIS for the Permitted Development, during the operation of the wind farm, the turbine manufacturer, the developer or a service company will carry out regular maintenance of the turbines. As noted in the EIS:

- During the life of the project, it is envisaged that at least two permanent jobs will be created locally in the form of an operator or maintenance personnel.
- In addition, operation and monitoring activities may be carried out remotely with the aid of computers connected via a telephone broadband link.
- Routine inspection and preventive maintenance visits will be necessary to ensure the smooth and efficient running of the wind farm.
- At the end of the 25 year lifespan of the project, the developers will make the decision whether to repower or decommission the turbines. This will be subject to a new planning permission application.

2.6. Decommissioning

It is considered that the decommissioning effects of the Proposed Development will not be altered from those of the Permitted Development as outlined in the EIS.

As set out in Condition 4 of the planning permission grant relating to the Permitted Development, the permitted operational lifespan is up to 25 years from full and final commissioning of all the of the proposed turbines. This is also the intended operational lifespan of the Proposed Development. At the end of the 25 year operational period, the wind farm would be decommissioned and the turbines dismantled and removed in line with Condition 12. Any alternative to this action would require consent and is not considered in this EIA Report.

During decommissioning, the turbines and foundations would likely be dismantled to below ground level in reverse order to how they were erected. All above ground turbine components would be separated and removed off-site for recycling. The recycling of turbine blades is currently the subject of significant research focus and it is envisaged that at the end of the wind farm lifespan the recycling of all turbine parts will be commonplace. The below ground elements and the crane hardstandings will be left in situ, along with the site roads, for use by the landowner. This approach is considered to be less environmentally damaging than seeking to remove foundations, cables and roads entirely. The approach to decommissioning will be confirmed based on best practice at the time. A decommissioning plan will be agreed with Galway County Council three months prior to decommissioning the Proposed Development. A decommissioning plan is contained in the CEMP in Appendix 2.1.

2.7. Site Context

2.7.1. Site Location

The site of the proposed development is located in the townlands of Knockranny, Ardderroo and Letter, County Galway, c.4.5 kilometres north-west of the small town of Moycullen and c. 3km to the south-west of the village of Rosscahill.

2.7.2. Site Access

The N59 (Galway – Clifden) National Secondary Road runs c. 2km to the east. The subject site is accessed via the L-53453 off the N59 which transitions to private roadway. This is the primary access route for the Ardderroo Wind Farm, the Galway Wind Park and local access.

2.7.3. Physical Characteristics of Site and Surrounding Lands

The site is in a remote upland area, where hills are interspersed with rough grazing, pockets of commercial forestry, and lowland blanket bog, cutover bog and wet heath areas. Landuses within the site and in the general area include forestry, agriculture and evidence of previous turbary. There are two large tracts of commercial coniferous forestry on the site, a section to the south and also on the west. A small stand of broadleaf trees also existing to the east of the site. The grid connection underground cabling route is contained within and adjacent to the existing Coillte access tracks that provides access to Coillte commercial forestry, wind farms (including the Ardderroo Wind Farm) and local land use (agriculture & turbary). The route is bounded by peat banks and extensive areas of Coillte commercial forestry.

There is a notable presence of wind projects in the local area, with the 25 turbine Ardderroo Wind Farm under construction immediately to the west, and the Galway Wind Park (60 turbines in operation) to the west and north-west of the site. A number of other wind farms are located to the south.

Knocknalee Hill, to the north-west reaches an elevation of 288mOD, while to the south-east Newtown Hill is 198mOD. Within the subject site there are two distinct peaks, one to the west at 134mOD and Knockranny Hill to the east at 183mOD. The land slopes from these summits to relatively flat ground in the lower slopes. The site is underlain by granite rock and there is an abundance of exposed rock interspersed with shallow soils throughout the site.

A number of streams drain the site, one of which 'Sruthan Chnocan Raithni' traverses the subject lands. The 'Lough Adereen Stream', 'Abhainn na nArd Doiriu' and 'Sruthan Bui' occur along or near site boundaries.

The N59 is situated to the east of the EIAR boundary, beyond which the lands transitions to predominantly flat terrain which slopes gently eastwards to the shore of Lough Corrib (SAC and SPA). Settlements and population clusters are aligned along the N59.

2.8. Planning History

This Section of the EIAR sets out the planning permission history of the EIAR site boundary and other wind farm sites within the wider area. It also describes other infrastructure projects which are existing or planned within the wider area.

2.8.1. Within Site Boundary

Pl. Ref. 11/375: Application by Western Power Developments Ltd. for the construction of a wind farm comprising of 14 no. turbines and ancillary works at Knockranny and Adderroo. Permission was granted by the Planning Authority but refused by An Bord Pleanála (PL.07.239053) in August 2012.

Under Galway County Council Reference 13/829 / An Bord Pleanála Reference PL07.243094, a subsequent 10 - year planning permission was granted on the 19th February 2016 for the Permitted Development described in Section 2.2.

2.8.2. Other Wind Farms in Vicinity

There are a number of existing windfarms, including the 174MW Galway Wind Park to the west and north-west of the study area. There are in addition, a number of permitted windfarms in the vicinity, such as the adjacent 25 turbine Ardderroo Windfarm, currently under construction. These are listed in Table 2.5.

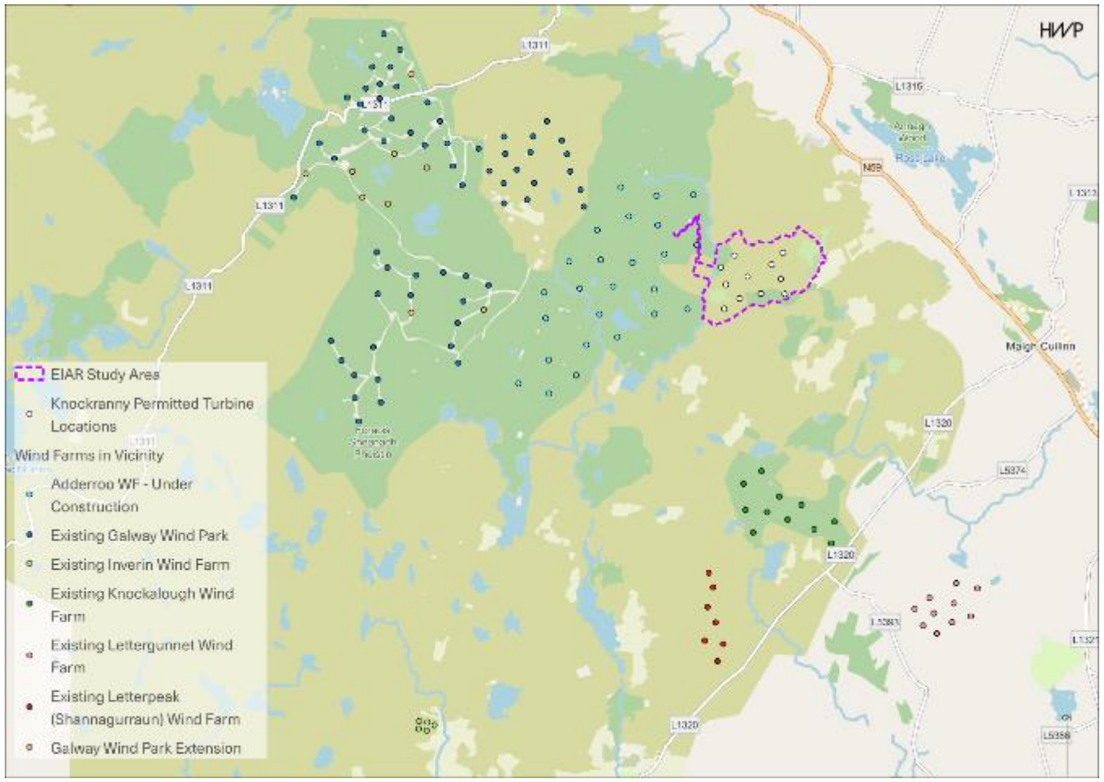

Figure 2.23 Operational & Permitted Wind Farms in Vicinity

Projects	Owner	No. of Turbines	Proximity to Development Lands	Description	Status
Ardderroo Wind Farm	Ardderroo Windfarm Ltd	25	27m	PA07.303086/303086 - Construction of up to 25 number wind turbines, one permanent meteorological mast, one 110kV substation and all associated site development works	Under construction – 22 turbines completed.
Inverin	Fuinneamh Teoranta	5	10.4km southwest	Pl. Ref: 96/1684: Application to construct a windfarm comprising 5 wind turbines in Inverin. Permission was granted in January 1997.	Existing

Projects	Owner	No. of Turbines	Proximity to Development Lands	Description	Status
Galway Wind Park (overall 69 Permitted and 60 constructed) Cloosh	Coillte Teoranta and SSE Renewables (Ireland)Ltd	22 Permitted 20 Constructed	4.3km west	Pl. Ref: 10/303: Construction of a wind farm comprising 22 no. wind turbines with a maximum tip of 140.5 metres and associated infrastructure in Finnaun. Permission was granted by the Planning Authority in June 2010. Of the 22 no. permitted wind turbines, 20 have been constructed and are now operational. This wind farm forms part of the Galway Wind Park.	Existing
Galway Wind Park - Uggool	SSE Renewables (Ireland) Ltd	16 Constructed	2.6km northwest	Pl. Ref. 11/1735, as amended by the subsequent permissions under Pl. Ref. 13/460 and Pl. Ref. 14/1423. This wind farm forms part of the Galway Wind Park development	Existing
Galway Wind Park Seecon	Coillte Teoranta and SSE Renewables (Ireland) Ltd	23 Permitted 16 Constructed	5.2km southwest	Pl. Ref: 11/429: Application by Coillte Teoranta and SSE Renewables Ltd. for the construction of 23 no. wind turbines in Seecon. Permission was granted by the Planning Authority in March 2011. This was appealed to An Bord Pleanála and granted in November 2011 under Pl.07.239118. Of the 23 no. permitted turbines 16 no. have been constructed and are now operational. This wind farm forms part of the Galway Wind Park. Pl. 19/1481: application for a 10 year permission for development at Derradda, Seecon, Shannapheasteen, Uggool, Letter, Finnaun consisting of a change to the dimensions of nine previously Permitted turbines (Galway County Council Planning Reference 10/303 and 11/429 and An Bord Pleanala Planning Reference PL07.239118) from a maximum hub height of 90m and rotor diameter of 101m with a maximum turbine tip height	Existing

Projects	Owner	No. of Turbines	Proximity to Development Lands	Description	Status
				of 140.5m, to a maximum rotor diameter of 138m with a maximum turbine tip height of 156m; Adjust the locations of three turbines as follows: T9 moved 6m, T30 moved 16m & T40 moved 16m; Provision of 1.9km of new internal wind farm access roads, localised upgrades to existing access roads. Underground cabling route connecting proposed turbines to the Knockranny substation at Letter, on or adjacent to existing wind farm roads. Three new borrow pits located adjacent to proposed T19, T20 and T31 for rock excavation and peat deposition; Extension of two existing / permitted borrow pit for the excavation of rock and the deposition of surplus peat material.	
Galway Wind Park Seecon and Cloosh	Coillte Teoranta and SSE Renewables (Ireland) Ltd	9	3km west	**Pl. 19/1481**: application for a 10 year permission for development at Derradda, Seecon, Shannapheasteen, Uggool, Letter, Finnaun consisting of a change to the dimensions of nine previously consented turbines (Galway County Council Planning Reference 10/303 and 11/429 and An Bord Pleanala Planning Reference PL07.239118) from a maximum hub height of 90m and rotor diameter of 101m with a maximum turbine tip height of 140.5m, to a maximum rotor diameter of 138m with a maximum turbine tip height of 156m; Adjust the locations of three turbines as follows: T9 moved 6m, T30 moved 16m & T40 moved 16m; Provision of 1.9km of new internal wind farm access roads, localised upgrades to existing access roads. Underground cable route connecting proposed turbines to the Knockranny substation at Letter, on or adjacent to existing wind farm roads. Three new borrow pits located adjacent to proposed T19, T20 and T31	Permitted

Projects	Owner	No. of Turbines	Proximity to Development Lands	Description	Status
				for rock excavation and peat deposition; Extension of two existing / permitted borrow pit for the excavation of rock and the deposition of surplus peat material. All on a site of approximately 76.07ha. Permission was granted by the Planning Authority in March 2020 and granted under appeal to An Bord Pleanála in December 2020.	
Lettercraffroe	SSE Renewables (Ireland) Ltd	8 Constructed	7.3km northwest	Pl. Ref: 10/1454: Application by SSE Renewable Ltd to construct a windfarm comprising 8 no. wind turbine and associated infrastructure in Lettercraffoe. Permission was granted by the Planning Authority in December 2010. This wind farm is now operational. Pl. Ref: 13/375: Application by SSE Renewables Ltd. for amendments to the permitted substation and access road granted under Pl. Ref 10/1454. Permission was granted by the Planning Authority in July 2013 This wind farm forms part of the Galway Wind Park.	Existing
Knockalough Wind Farm	Knockalough Wind Farm Ltd	11	3km south	Pl. Ref. 14/1273: Application by Knockalough Wind Farm Ltd. to construct a wind farm comprising 11 no. turbines and associated infrastructure in the townlands of Knockalough, Finisklin and Laughil. Permission was granted by the Planning Authority on the 5th October 2015. Pl. Ref. 16/1211: Application by Knockalough Wind Farm Ltd. for the relocation of one turbine (Turbine no. 4) and associated infrastructure of the previously permitted Knockalough Wind Farm (Pl. Ref. 14/1273) and the provision of additional internal access road. Permission was granted by the Planning	Existing
				Authority in October 2016, and granted following appeal by An Bord Pleanála under PL07.247605 in October 2017.	
Leitir Gungaid (Lettergunnet)	Coir na Gaoithe Teoranta	10	6.9km south - southeast	Pl. Ref: 03/4656: Application for 8 no. turbines in Lettergunnet and Derrycrih granted in May 2004. Pl. Ref: 09/1326: Application to amend permission Ref 03/4656 to change the proposed turbine and increase the hub height from 60 metres to 64 metres. Permission was granted by the Planning Authority in August 2009 and granted under appeal to An Bord Pleanála in March 2010. Pl. Ref: 10/1214: Application to amend Pl. Ref: 09/1326 to comprise 10 no. wind turbines and changes to associated site layout. Permission was granted by the Planning. Authority in March 2011.	Existing
Letterpeck (Shannagurran & Truskaunngappul)	Coir na Gaoithe Teoranta	7	5.3km south	Pl. Ref: 10/1225: Application to construct a windfarm comprising of 7 no. wind turbines in Shannagurran and Truskaunnagappul. Granted by the Planning Authority in September 2010 and granted on appeal to An Bord Pleanála in October 2011.	Existing

Table 2.5 Permitted Wind Farms in Vicinity

2.8.3. Other Planning History in the Vicinity

Development Name	Application Ref	Description
Doon Road Upgrade	Pl. Ref. 13/658	Permission for modification and improvements to existing roads and tracks for the Galway Wind Park turbine delivery route. This application was granted by Galway County Council on the 25th July 2013. The permission provides for the modification and improvement to 8.06 kilometres of the Doon Road, including the junction of the Doon Road with the N59. Of the 8.06 kilometres of road

		improvements, 4.86 kilometres are within the proposed Ardderroo wind farm site boundary. These modifications and improvements have been completed
West Galway (Letter) 110/38kV Electricity Substation	Pl. 07VA0016 & Pl. Ref 15/1195	The West Galway, or Letter, 110kV Electricity Substation comprises of a 110/38kV electricity substation and associated works in the townlands of Letter, Doon and Killaguile, and partially within the Ardderroo wind farm site. An Bord Pleanála granted planning permission to Eirgrid plc for the substation in October 2013, to facilitate the connection of wind farm developments that have accepted their grid connection offers in West Galway to connect to the national grid. While the substation and associated peat disposal areas are located within the Ardderroo wind farm site boundary, the permission also provides for underground cabling works and new overhead line structures further east of the Ardderroo site. A subsequent retention application was permitted for modifications to the permitted substation.

Table 2.6 Other Relevant Planning History

CNOC RAITHNÍ (KNOCKRANNY) WIND FARM

CHAPTER 3

Alternatives Considered

CHAPTER 3 - Alternatives

Contents

3. ALTERNATIVES CONSIDERED

3.1. Introduction

Article 5(1) of the Directive 2011/92/EU, as amended by Directive 2014/52/EU states that.

> *d) a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment.*
>
> *f) any additional information specified in Annex IV relevant to the specific characteristics of a particular project or type of project and to the environmental features likely to be affected.*

Annex IV point 2 expands further.

> *2) A description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects.*

Article 94 and Schedule 6, paragraph 1(d) of the Planning and Development Regulations 2001, as amended, requires the following information to be furnished in relation to alternatives:

> *(d) A description of the reasonable alternatives studied by the person or persons who prepared the EIAR, which are relevant to the proposed development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the proposed development on the environment.*

The purpose of this chapter is to describe the reasonable alternatives considered by the developer, including alternatives considered through the design and consultation phases of the project, taking into account and comparing environmental effects and illustrating the manner in which, and reasons for, choosing the Proposed Development.

Regarding 'Reasonable Alternatives', the Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment' (2018) states that:

> *The Directive requires that information provided by the developer in an EIAR shall include a description of the reasonable alternatives studied by the developer. These are reasonable alternatives which are relevant to the project and its specific characteristics. The developer must also indicate the main reasons for the option chosen taking into account the effects of the project on the environment.*
>
> *Reasonable alternatives may relate to matters such as project design, technology, location, size and scale. The type of alternatives will depend on the nature of the project proposed and the characteristics of the receiving environment. For example, some projects may be site specific so the consideration of alternative sites may not be relevant. It is generally sufficient for the developer to provide a broad description of each main alternative studied and the key environmental issues associated with each. A 'mini- EIA' is not required for each alternative studied.*

Further the 2022 EPA Guidelines on the Information to be Contained in Environmental Impact Assessments are also instructive in stating:

> *Analysis of high-level or sectoral strategic alternatives cannot reasonably be expected within a project level EIAR… It should be borne in mind that the amended Directive refers to 'reasonable alternatives… which are relevant to the proposed project and its specific characteristics.*

This chapter considers the following:

- Do-nothing scenario,
- Alternative location,
- Alternative layouts and design,
- Alternative processes for development.

The main alternatives examined throughout the design and consultation process are included, to indicate the primary reasons for choosing the Proposed Development, considering and providing a comparison of the environmental effects.

3.2. Do-Nothing Alternative

In consideration of the 'do nothing' scenario on the site, the permitted turbines would proceed unamended and the opportunity to increase the generating potential of the site would be lost. The permitted on-site substation would have to be constructed instead of the more efficient extension to the Ardderroo Substation. Therefore, the 'do-nothing scenario' represents a significantly lower contribution to achieving the country's renewable energy targets and in reducing Ireland's dependency on fossil fuels.

A "do-nothing" scenario is considered to represent an inappropriate unsustainable and inefficient use of lands on which a wind farm project is permitted, broadly within a designated strategic wind area within County Galway, which is recognised in the County Development Plan 2022 (CDP) to have '*above average wind energy potential …in both onshore and offshore'*.

3.3. Alternative Locations

As stated above, regarding alternative locations, Section 3.4.1 of the 2022 EPA Guidelines, recognise that:

> *'in some instances some of the alternatives described below will not be applicable' – e.g. there may be no relevant 'alternative location'…".*

The subject lands are available to Western Power Developments Limited, with planning permission already extant for an 11 no. turbine windfarm at this location, therefore, the principle of wind energy development is firmly established at this location. The suitability of the subject lands is evident in the fact that they are principally located within a strategic wind energy area in the County Galway Local Authority Renewable Energy Strategy (LARES) Wind Development Potential Map. They are adjacent to the largest onshore wind farm in Ireland (Galway Wind Park – 172MW) and immediately adjacent to Ardderroo Wind Farm. The latter is a significant Strategic Infrastructure Development with 25 no. turbines at a permitted blade tip height of 178.5m, which is currently under-construction. The LARES notes the *'recognised above average wind energy potential that Galway possesses both onshore and offshore'*.

The existing planning permission for an 11 no. turbine wind farm, (as permitted under Galway County Council Reference 13/829 / An Bord Pleanala Reference PL07.243094) not only establishes the principle of a wind development at this location but also indicates that the environmental effects have already been assessed by the Council, consultees, and An Bord Pleanála (ABP) and considered to be acceptable.

Western Power Developments Limited have not yet had an opportunity to construct the consented Wind Farm. In the context of the Government's Climate Action Plan 2021, and subsequent iterations, with increased national targets for renewable electricity from 70 % by 2030 to 80 % by 2030 and to reach net-zero emissions by no later than 2050, the Applicants are taking steps to implement this planning permission. A suitable grid connection has now been established through the recently constructed Ardderroo substation, with a small extension to the existing substation facilitating the connection to the national grid in lieu of constructing the permitted on-site substation.

A reasonable alternative would have been for Western Power Developments Limited to identify and assess a new wind farm site which could have resulted in significant environmental effects at the alternative location. However, as the existing planning permission indicates, the subject site has a proven capacity to accommodate a large-scale wind farm development.

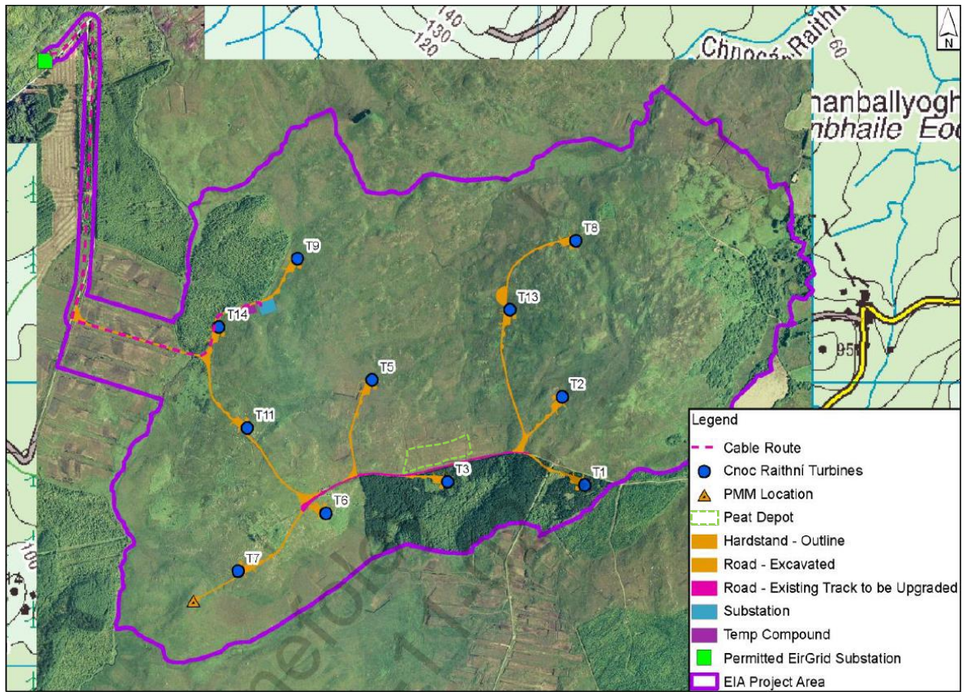

Figure 3.1 Summary Outline of Permitted Windfarm and associated EIA Study Area (based on Fig 2.4 Malachy Walsh EIA 2013)

Alongside that the subject lands have largely been identified in the Galway County Development Plan 2015 as well as the current CDP, as a strategic area for wind energy development. Both plans have been subject to Strategic Environmental Assessment which will have taken into account the environmental considerations associated, for example, with the cumulative impact of an area zoned for development on a sensitive landscape.

We note the 2022 EPA Guidelines, which state.

> *'Analysis of high-level or sectoral strategic alternatives cannot reasonably be expected within a project level EIAR… It should be borne in mind that the amended Directive refers to 'reasonable alternatives… which are relevant to the proposed project and its specific characteristics.'*

3.4. Alternative Layouts and Design

As part of Western Power Developments Limited's technical review of the permitted wind farm, consideration was given to potentially redesigning the permitted wind farm turbine layout and increasing the turbine heights further than that proposed.

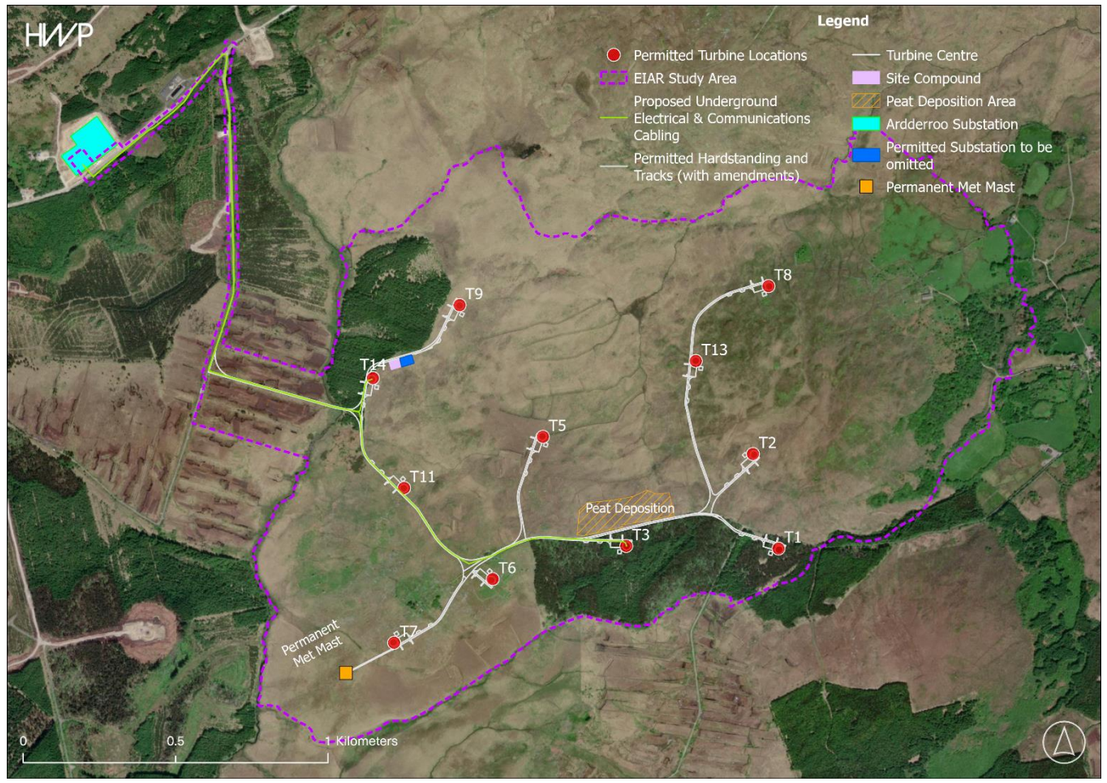

Figure 3.2 Proposed Alterations to Wind Farm

Following a review of the permitted turbine layout; the Applicant has resolved to minimise the potential for any increased environmental effects by maintaining the same number of turbines in an unchanged turbine layout configuration from the Permitted Development. While the turbine number and locations are being maintained, as outlined in more detail in Section 2. of this EIAR, the permitted tip height of up to 140.5m has been reconsidered having regard to turbine technology developments since the original layout design in 2013, with a standard tip height of 150m now being proposed (Ref. Table 3.1). The proposed change in turbines will necessitate some revisions to the size of supporting foundations. However, while in the original permitted layout, 6 no. turbines had a hub height of 90m and 5 no. turbines had a hub height of 80m, it is now proposed that all turbines will have a hub height of 81m or 82m depending on the chosen option of the two options assessed in this EIAR. As noted in Chapter 4 of this EIAR, the reduced visual impact resulting from the proposed reduction in hub height of the majority of turbines will contribute towards balancing any increased visual impact arising from the increased tip-height.

Turbine ID	Permitted		Proposed - Option 1 (136m Rotor diameter)		Proposed - Option 2 (138m Rotor diameter)	
	Hub Height	Tip Height	Hub Height	Tip Height	Hub Height	Tip Height
Turbine 1	80	130.5	82	150	81	150
Turbine 2	80	130.5	82	150	81	150
Turbine 3	80	130.5	82	150	81	150
Turbine 5	90	140.5	82	150	81	150
Turbine 6	90	140.5	82	150	81	150
Turbine 7	90	140.5	82	150	81	150
Turbine 8	80	130.5	82	150	81	150
Turbine 9	90	140.5	82	150	81	150
Turbine 11	90	140.5	82	150	81	150
Turbine 13	80	130.5	82	150	81	150
Turbine 14	90	140.5	82	150	81	150

Table 3.1 Permitted and proposed turbine dimensions

The proposed increase in overall turbine height to 150m will result in enhanced efficiency and an increased rated electrical power output of between c.14 – 16 MW per hour. An alternative option would have been to maintain the turbine heights as permitted. However, the Applicant's preference is to pursue an efficiency improvement of the proposed development with what is considered to be a relatively minor adjustment in tip height, when compared to other projects permitted locally.

The Applicant revisited the proposal to include an on-site substation in the context of recent substation infrastructural changes in the vicinity. A technical review has concluded that provision of a new 110kV on-site substation and connection to Galway West (Knockranny) Substation is no longer the optimal approach and the construction of an additional 110kV substation in the local environment can be avoided. The proposed amendments include the omission of the previously permitted substation on-site and amendments to the previously assessed underground cabling to provide a grid connection via an extension to the Ardderroo substation. This cable route effectively represents an extension to the route assessed under the previously prepared EIS.

This will include the laying of cables collecting the amalgamated power from the turbines within the wind farm, following proposed wind farm roads, existing road to be upgraded, existing Ardderroo wind farm road and a new track following the southern verge of the east west access road to the Ardderroo Substation. In addition, this amended approach will require the provision of an extension (c. 75m^2) of the Ardderroo substation control building and associated plant and electrical equipment to connect to the national grid, all within the existing Ardderroo substation compound.

Other alternative options would have been to substantially redesign the site layout, which may have resulted in alternative and potentially more significant environmental effects than those identified and successfully mitigated for in the Permitted Development layout. The mitigation measures set out in relation to the Permitted Development will be adhered to. Furthermore, the Proposed Development has been carefully designed to ensure that any alteration to the environmental impact of the Permitted Development is of minor significance, with appropriate mitigation proposed, or represent a positive contribution.

3.4.2. Construction Stage

The Environmental Impact Statement (EIS) for the Permitted Development outlined the requirements for the management of processes involved in each stage of construction. Building upon that, the various chapters of this EIAR and the Construction Environmental Management Plan (CEMP), enclosed as Appendix 2-1, consider the management of processes in relation to the construction of the Project. As the previous EIS included consideration of underground cabling within the site as well as a 2km 110kV underground grid connection cabling to the Galway West substation, it is not considered that there will be significant additional construction effects arising from the extension of the cable route to the Ardderroo substation. Specifically, it is determined that the amendments will not give rise to significant additional construction traffic.[1] The turbine delivery route corresponds to that which was recently utilised successfully for the larger Ardderroo turbines. Impacts on land and soil resources, in the form of excavated material will be slightly altered due to the omission of the on-site substation and alteration to the turbine foundation design and underground cabling route. Similarly, no significant additional impacts are envisaged on water resources.

The proposed layout has been selected in order to minimise the changes to the processes which were deemed acceptable in the Permitted Development. However, the use of any additional resources will be managed by the employment of standard, good practice construction methods and construction management plans as outlined in the enclosed CEMP (ref. Appendix 2.1). In addition, the CEMP covers elements such as waste management practices. An alternative to this approach would be to deviate from the previously accepted and best practice construction methodologies and processes which was not the preferred option.

3.4.3. Operational Stage

The processes used during the operational phase of any wind farm, are relatively minimal i.e. there is no requirement for the use of natural resources, significant traffic volumes or the generation of waste. It is not envisaged, therefore, that the proposed amendment, will give rise to any significant additional operational processes.

The increased turbine dimensions could potentially result in increased operational impacts. These have been specifically assessed in the relevant chapters of this EIAR, with appropriate mitigation recommended where considered necessary to ensure no significant residual impact arises.

3.5. Alternative Mitigation

The original EIS fully assessed all environmental aspects and proposed suitable mitigation where required. These measures, in conjunction with the conditions attached by An Bord Pleanála (ABP) in their decision to grant permission (An Bord Pleanala Reference PL07.243094), form a comprehensive suite of mitigation measures which will ensure that potential risks are minimised.

The individual chapters of this EIAR contain analysis of the proposed amendments in comparison with the Permitted Development and further mitigation measures have been proposed where required to ensure any potential effects arising from the Proposed Development will not result in a significant impact. An alternative to this approach would be to deviate from the best practice mitigation and monitoring proposals that were set out in the original Permitted Development documentation and further supplemented where necessary in the EIAR, this was not the preferred option.

3.6. Conclusion

As required under Article 5(1) of the Directive 2011/92/EU, as amended by Directive 2014/52/EU the applicant has considered the various reasonable alternatives to the Proposed Development.

The primary consideration of the Applicant in so doing was to minimise environmental impacts while ensuring the optimal and most efficient use of these lands, which are broadly designated by Galway County Council as a strategic area for wind potential. The Proposed Development will positively contribute towards the achievement of Ireland's onshore wind capacity targets and support the transition to a low carbon society and economy. The principal elements of the design evolution were informed by advances in turbine technology and changes in the available electricity infrastructure provision in the immediate vicinity of the site.

The proposed layout has been carefully developed to minimise changes to the permitted wind farm whilst optimising and increasing efficiency. It is considered to be an appropriate balance between optimising the wind farm's renewable energy generation capacity, whilst avoiding or minimising the introduction of new and significant adverse environmental effects.

[1] Refer to Chapter 5 of this EIAR where the uplift in construction trip numbers is discussed in detail.

CNOC RAITHNÍ (KNOCKRANNY) WIND FARM

CHAPTER 4

Landscape and Visual Impact

VOLUME II EIAR

CHAPTER 4 - LANDSCAPE AND VISUAL IMPACT

Contents

Chapter 4

4. LANDSCAPE AND VISUAL IMPACT

4.1. Introduction

This chapter presents the findings of a Landscape and Visual Impact Assessment undertaken to evaluate the effects of the Proposed Development relative to the Permitted Development at Cnoc Raithni (Knockranny), Wind Farm, as described in Chapter 2 of this EIAR.

Landscape Impact Assessment (LIA) relates to changes in the physical landscape brought about by a development, which may alter its character, and how this is experienced. This requires a detailed analysis of the individual elements and characteristics of a landscape that go together to make up the overall landscape character of that area. By understanding the aspects that contribute to landscape character, it is possible to make judgements in relation to its quality (integrity) and to identify key sensitivities. This, in turn, provides a measure of the ability of the landscape in question to accommodate the type and scale of change associated with the development without causing unacceptable adverse changes to its character.

Visual Impact Assessment (VIA) relates to assessing effects on specific views and on the general visual amenity experienced by people. This deals with how the surroundings of individuals or groups of people may be specifically affected by changes in the content and character of views as a result of the change or loss of existing elements of the landscape and/or introduction of new elements. Visual impacts may occur from: visual obstruction (blocking of a view, be it full, partial or intermittent) or Visual Intrusion (interruption of a view without blocking).

Cumulative landscape and visual impact assessment is concerned with additional changes to the landscape or visual amenity caused by the Proposed Development in conjunction with other developments (associated or separate to it), or actions that occurred in the past, present or are likely to occur in the foreseeable future.

4.1.1. Background and Objectives

This chapter of the EIAR assesses the impacts of the Proposed Development on the landscape and visual amenity of the receiving environment. Although closely linked, landscape and visual impacts are assessed separately. Where negative effects are predicted, the chapter identifies appropriate mitigation strategies therein. The assessment will consider the potential effects during the following phases of the Development:

- Construction of the Proposed Development
- Operation of the Proposed Development
- Decommissioning of the Proposed Development (final phase)

'The Proposed Development' refers to all elements of the current planning application for alterations to the permitted Cnoc Raithni (Knockranny) Wind Farm.

This chapter of the EIAR is supported by a portfolio of photomontages which are attached as a separate booklet and the associated Visual Impact Assessment at VPs, can be found in Appendix 4.1. This appraisal utilises comparative photomontages from the same 20 viewpoint locations submitted with the original planning application and one additional viewpoint location, with the Permitted Development assuming the baseline condition. The comparative assessment of tip height increase will be from variable tip heights of 130.5m / 140.5m up to a single consolidated tip height of 150m. This is on the basis that 5 no. of the permitted turbines have a tip height of 130.5m and the remaining 6 no. are permitted at a tip height of 140.5. Two potential (candidate) turbines specifications are proposed to achieve the 150m tip height. These very similar specification turbines include the 'V136' option with a 136m rotor diameter and 82m hub height and the 'V138' option with a 138m rotor diameter and 81m hub height. For the purposes of the visual impact assessment, the 'V136' higher hub height turbine is used as the 'specimen' turbine in the photomontages. The 1m variation in hub height and 2m variation in rotor dimeter between this and the 'V138' turbine option is immaterial to the landscape and visual assessment and this is illustrated in a series of comparative photomontage views.

Other proposed changes include the provision of an extension to the Ardderroo Substation in lieu of the previously approved on-site substation, alteration to the underground cabling route, and associated site works. Refer to Chapter 2 for a full description of the Proposed Development.

4.1.2. Assessment Structure

In line with the Guidelines for Landscape and Visual Impact Assessment (2013), the structure of this chapter will consist of separate considerations of landscape effects and visual effects in the following order:

- Assessment of landscape value and sensitivity
- Assessment of the magnitude of landscape effects within the Study Area; (comprised of the 'Central Study Area' (within c. 5km of the proposed turbines) and 'Wider Study Area' (5-20km from the proposed turbines)
- Assessment of the significance of landscape impacts
- Assessment of visual receptor sensitivity
- Assessment of visual impact magnitude at representative viewpoint locations (using photomontages)
- Assessment of visual impact significance
- Assessment of cumulative landscape and visual impacts

4.1.3. Statement of Authority

This Landscape and Visual Impact Assessment was prepared by Richard Barker, Principal Landscape Architect, and Jorden Derecourt, Landscape Architect at Macro Works Ltd. Detailed competencies are included within Chapter 1.

4.2. Assessment Methodology

Production of this Landscape and Visual Impact Assessment (LVIA) involved baseline work in the form of desktop studies and fieldwork comprising professional evaluation by qualified and experienced Landscape Architects. This entailed the following:

4.2.1. Desktop Study

- Establishing an appropriate Study Area from which to study the landscape and visual impacts of the Development.

- Review of a Zone of Theoretical Visibility (ZTV) map, which indicates areas from which the Development is potentially visible in relation to terrain within the Study Area.
- Review of relevant County Development Plans, particularly with regard to sensitive landscape and scenic view/route designations.
- Selection of potential Viewshed Reference Points (VRPs) from key visual receptors to be investigated during fieldwork for actual visibility and sensitivity.

4.2.2. Fieldwork

- Recording of a description of the landscape elements and characteristics within the Study Area.
- Recapturing of reference images and grid reference coordinates for each of the previous VRPs location for the visualisation specialist to prepare updated / comparative photomontages.

4.2.3. Appraisal

- Consideration of the receiving landscape with regard to overall landscape character as well as the salient features of the Study Area including landform, drainage, vegetation, land use and landscape designations.
- Consideration of the visual environment including receptor locations such as centres of population and houses, transport routes, public amenities and facilities and designated and recognised views of scenic value.
- Consideration of design guidance and planning policies.
- Consideration of potentially significant construction stage and operational stage effects and the mitigation measures that could be employed to reduce such effects.
- Estimation of the significance of residual landscape impacts.
- Estimation of the significance of residual visual impacts aided by photomontages prepared at all of the selected VRP locations.
- Estimation of cumulative landscape and visual effects in combination with other surrounding developments that are either existing or permitted.

4.2.4. Relevant Legislation and Guidance

This LVIA uses methodology as prescribed in the following guidance documents:

- Environmental Protection Agency (EPA) publication 'Guidelines on the Information to be contained in Environmental Impact Statements (2022) and the accompanying Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (Draft 2015).
- Landscape Institute and the Institute of Environmental Management and Assessment publication entitled Guidelines for Landscape and Visual Impact Assessment – Third Addition (2013).
- NatureScot Guidance: Assessing the cumulative landscape and visual impact of onshore wind energy developments.
- Department of the Environment, Heritage and Local Government Wind Energy Development Guidelines (2006)[1] and reference to Preferred Draft Approach to revising the 2006 Guidance published 2017 and Draft Wind Energy Development Guidelines, published 2019.
- Scottish Natural Heritage (SNH) Visual representation of wind farms: Best Practice Guidelines (version 2.2 - 2017).

4.2.5. Definition of Study Area

The Wind Energy Development Guidelines published by the Department of the Environment, Heritage and Local Government (2006) specify different radii for examining the zone of theoretical visibility of proposed wind farm projects (ZTV). The extent of this search area is influenced by turbine height, as follows:

- 15km radius for blade tip height of up to 100m
- 20km radius for blade tip height of greater than 100m
- 25km radius where landscapes of national and international importance exist.

In the case of this assessment, the blade tip height is 150m and, thus, the minimum ZTV radius recommended is 20km from the outermost turbines of the scheme. There are no sites of national or international importance between 20 – 25km and thus, the radius of the study area will remain at 20km.

4.2.6. Computer Generated Images, Photomontages and Wireframes

This LVIA is supported by a variety of computer-generated maps and graphics as well as verifiable photomontages that depict the Proposed Development within the views from a range of represented visual receptor locations, which are mainly the same as those used for the EIS which accompanied the planning application for the Permitted Development. These maps, graphics and visualisations consist of the following:

- Zone of Theoretical Visibility (ZTV) maps.
- Photomontages consisting of 'imminent baseline' views, wireframe views and proposed views.

4.2.6.1. Assessment Approach for Candidate Turbine Options

In this instance, two candidate turbine options are proposed and rather than produce a full set of photomontages for both turbine dimensions, it was elected to use one of the candidate turbine dimensions for the full set of photomontages. A sample of four viewpoint locations, predominantly in close proximity to the site, is then used to illustrate the lack of a discernible difference between the two candidate turbines. The V136 option was selected as the specimen turbine to be used for all photomontages, because its higher hub height may have potential for hubs to appear above ridgelines to a greater degree than the V138 option. However, with a difference of just 1m in hub heights, either option could have been used as the variation is likely to be imperceptible.

4.2.7. Assessment Criteria for Landscape Effect

The classification system used by Macro Works to determine the significance of landscape and visual impacts is based on the IEMA Guidelines for Landscape and Visual Impact Assessment (2013). When assessing the potential impacts on the landscape resulting from a wind farm development, the following criteria are considered:

- Landscape character, value and sensitivity
- Magnitude of likely impacts

[1] Subsequently referred to as Wind Energy Development Guidelines (WEDG) in different sections of this EIAR.

- Significance of landscape effects

The sensitivity of the landscape to change is the degree to which a particular landscape receptor (Landscape Character Area (LCA) or feature) can accommodate changes or new features without unacceptable detrimental effects to its essential characteristics. Landscape Value and Sensitivity is classified using the following criteria:

Sensitivity	Description
Very High	Areas where the landscape character exhibits a very low capacity for change in the form of development. Examples of which are high value landscapes, protected at an international or national level (World Heritage Site/National Park), where the principal management objectives are likely to be protection of the existing character.
High	Areas where the landscape character exhibits a low capacity for change in the form of development. Examples of which are high value landscapes, protected at a national or regional level (Area of Outstanding Natural Beauty), where the principal management objectives are likely to be considered conservation of the existing character.
Medium	Areas where the landscape character exhibits some capacity and scope for development. Examples of which are landscapes which have a designation of protection at a county level or at non-designated local level where there is evidence of local value and use.
Low	Areas where the landscape character exhibits a higher capacity for change from development. Typically, this would include lower value, non-designated landscapes that may also have some elements or features of recognisable quality, where landscape management objectives include, enhancement, repair and restoration.
Negligible	Areas of landscape character that include derelict, mining, industrial land or are part of the urban fringe where there would be a reasonable capacity to embrace change or the capacity to include the development proposals. Management objectives in such areas could be focused on change, creation of landscape improvements and/or restoration to realise a higher landscape value.

Table 4.1 Landscape Value and Sensitivity

The magnitude of a predicted landscape impact is a product of the scale, extent or degree of change that is likely to be experienced as a result of the development. The magnitude takes into account whether there is a direct physical impact resulting from the loss of landscape components and/or a change that extends beyond the site boundary that may have an effect on the landscape character of the area.

Sensitivity	Description
Very High	Change that would be large in extent and scale with the loss of critically important landscape elements and features, that may also involve the introduction of new uncharacteristic elements or features that contribute to an overall change of the landscape in terms of character, value and quality.
High	Change that would be more limited in extent and scale with the loss of important landscape elements and features, that may also involve the introduction of new uncharacteristic elements or features that contribute to an overall change of the landscape in terms of character, value and quality.
Medium	Changes that are modest in extent and scale involving the loss of landscape characteristics or elements that may also involve the introduction of new uncharacteristic elements or features that would lead to changes in landscape character, and quality.
Low	Changes affecting small areas of landscape character and quality, together with the loss of some less characteristic landscape elements or the addition of new features or elements.
Negligible	Changes affecting small or very restricted areas of landscape character. This may include the limited loss of some elements or the addition of some new features or elements that are characteristic of the existing landscape or are hardly perceivable.

Table 4.2 Magnitude of Landscape Impacts

The significance of a landscape impact is based on a balance between the sensitivity of the landscape receptor and the magnitude of the impact. The significance of landscape impacts is arrived at using the following matrix:

	Sensitivity of Receptor				
Scale/ Magnitude	Very High	High	Medium	Low	Negligible
Very High	Profound	Profound-substantial	Substantial	Moderate	Slight
High	Profound-substantial	Substantial	Substantial-moderate	Moderate-slight	Slight-imperceptible
Medium	Substantial	Substantial-moderate	Moderate	Slight	Imperceptible
Low	Moderate	Moderate-slight	Slight	Slight-imperceptible	Imperceptible
Negligible	Slight	Slight-imperceptible	Imperceptible	Imperceptible	Imperceptible

Table 4.3 Landscape Impact Significance Matrix

Note: Judgements deemed 'substantial' and above are considered to be 'significant impacts' in EIA terms.

4.2.8. Assessment Criteria for Visual Effect

As with the landscape impact, the visual impact of the development will be assessed as a function of receptor sensitivity versus magnitude. In this instance, the sensitivity of visual receptors, weighed against the magnitude of visual effects.

4.2.8.1. Visual Sensitivity

Unlike landscape sensitivity, visual sensitivity has an anthropocentric basis. Visual sensitivity is a two-sided analysis of receptor susceptibility (people or groups of people) versus the value of the view on offer at a particular location.

To assess the susceptibility of viewers and the amenity value of views, the assessors use a range of criteria and provide a four-point weighting scale to indicate how strongly the viewer/view is associated with each of the criterion. Susceptibility criteria is extracted directly from the IEMA Guidelines for Landscape and Visual Assessment (2013), whilst the value criteria relate to various aspects of a view that might typically be related to high amenity including, but not limited to, scenic designations. These are set out below:

- **Susceptibility of receptor group to changes in view.** This is one of the most important criteria to consider in determining overall visual sensitivity because it is the single category dealing with viewer susceptibility. In accordance with the IEMA Guidelines for Landscape and Visual Assessment (3rd edition 2013) visual receptors most susceptible to changes in views and visual amenity are:
  - "Residents at home
  - People, whether residents or visitors, who are engaged in outdoor recreation, including use of public rights of way, whose attention or interest is likely to be focused on the landscape and on particular views
  - Visitors to heritage assets, or to other attractions, where views of the surroundings are an important contributor to the experience
  - Communities where views contribute to the landscape setting enjoyed by residents in the area
  - Travellers on road, rail or other transport routes where such travel involves recognised scenic routes and awareness of views is likely to be heightened."
- "Visual receptors that are less susceptible to changes in views and visual amenity include:
  - People engaged in outdoor sport or recreation, which does not involve or depend upon appreciation of views of the landscape
  - People at their place of work whose attention may be focussed on their work or activity, not their surroundings and where the setting is not important to the quality of working life."

4.2.8.2. Value of Views

To assess the amenity value of views, Macro Works use a range of criteria that might typically be related to high amenity value including but not limited to, scenic designations. These are set out below:

- **Recognised scenic value of the view** (County Development Plan designations, guidebooks, touring maps, postcards etc). These represent a consensus in terms of which scenic views and routes within an area are strongly valued by the population because in the case of County Development Plans, at least, a public consultation process is required.
- **Views from within highly sensitive landscape areas**. Again, highly sensitive landscape designations are usually part of a county's Landscape Character Assessment, which is then incorporated with the County Development Plan and is therefore subject to the public consultation process. Viewers within such areas are likely to be highly attuned to the landscape around them.
- **Intensity of use, popularity.** Whilst not reflective of the amenity value of a view, this criterion relates to the number of viewers likely to experience a view on a regular basis and whether this is significant at county or regional scale.
- **Connection with the landscape**. This considers whether or not receptors are likely to be highly attuned to views of the landscape i.e. commuters hurriedly driving on busy national route versus hill walkers directly engaged with the landscape enjoying changing sequential views over it.
- **Provision of elevated panoramic views**. This relates to the extent of the view on offer and the tendency for receptors to become more attuned to the surrounding landscape at locations that afford broad vistas.
- **Sense of remoteness and/or tranquillity.** Remote and tranquil viewing locations are more likely to heighten the amenity value of a view and have a lower intensity of development in comparison to dynamic viewing locations such as a busy street scene, for example:
- **Degree of perceived naturalness**. Where a view is valued for the sense of naturalness of the surrounding landscape it is likely to be highly sensitive to visual intrusion by obvious human interventions.
- **Presence of striking or noteworthy features.** A view might be strongly valued because it contains a distinctive and memorable landscape feature such as a promontory headland, lough or castle.
- **Historical, cultural or spiritual value.** Such attributes may be evident or sensed at certain viewing locations that attract visitors for the purposes of contemplation or reflection heightening the sense of their surroundings.
- **Rarity or uniqueness of the view.** This might include the noteworthy representativeness of a certain landscape type and considers whether other similar views might be afforded in the local or the national context.
- **Integrity of the landscape character in view.** This criterion considers the condition and intactness of the landscape in view and whether the landscape pattern is a regular one of few strongly related components or an irregular one containing a variety of disparate components.
- **Sense of place**. This criterion considers whether there is special sense of wholeness and harmony at the viewing location.
- **Sense of awe**. This criterion considers whether the view inspires an overwhelming sense of scale or the power of nature.

Those locations where highly susceptible receptors or receptor groups are present and which are deemed to satisfy many of the view value criteria above are likely to be judged to have a high visual sensitivity and vice versa.

4.2.8.3. Visual Impact Magnitude

The magnitude of visual effects is determined on the basis of two factors; the visual presence of the proposal and its effect on visual amenity.

Visual presence is a somewhat quantitative measure relating to how noticeable or visually dominant the proposal is within a particular view. This is based on a number of aspects beyond simply scale in relation to distance. Some of these include the extent of the view as well as its complexity and the degree of existing contextual movement experienced such as might occur where turbines are viewed as part of / beyond a busy street scene. The backdrop against which the development is presented and its relationship with other focal points or prominent features within the view is also considered. Visual presence is essentially a measure of the relative visual dominance of the proposal within the available vista and is expressed as such i.e. minimal, sub-dominant, co-dominant, dominant, highly dominant.

For wind energy developments, a strong visual presence is not necessarily synonymous with adverse impact. Instead, the 2012 Fáilte Ireland survey entitled 'Visitor Attitudes On The Environment – Wind farms' found that:

> *"Compared with other types of development in the Irish landscape, wind farms elicited a positive response when compared to telecommunication masts and steel electricity pylons"*

….and that:

"most (tourists) *felt that their presence did not detract from the quality of their sightseeing, with the largest proportion (45%) saying that the presence of the wind farm had a positive impact on their enjoyment of sightseeing…".*

The purpose here is not to suggest that turbines are either inherently liked or disliked, but rather to highlight that the assessment of visual impact magnitude for wind turbines is more complex than just the degree to which turbines occupy a view. Furthermore, a clear and comprehensive view of a wind farm might be preferable in many instances to a partial, cluttered view of turbine components that are not so noticeable within a view. On the basis of these reasons, the visual amenity aspect of assessing impact magnitude is qualitative and considers such factors as the spatial arrangement of turbines both within the scheme and in relation to surrounding terrain and land cover. It also examines whether the Development contributes positively to the existing qualities of the vista or results in distracting visual effects and disharmony.

It should be noted that as a result of this two-sided analysis, a high order visual presence can be moderated by a low level of effect on visual amenity and vice versa. Given that wind turbines do not represent significant bulk; visual impacts result almost entirely from visual 'intrusion' rather than visual 'obstruction' (the blocking of a view). The magnitude of visual impacts is classified in the following table derived from the Guidelines for Landscape and Visual Impact Assessment:

Sensitivity	Description
Very High	The proposal obstructs or intrudes into a large proportion or critical part of the available vista and is without question the most noticeable element. An extensive degree of visual change will occur within the scene completely altering its character, composition and associated visual amenity
High	The proposal obstructs or intrudes into a significant proportion or important part of the available vista and is one of the most noticeable elements. A considerable degree of visual change will occur within the scene substantially altering its character, composition and associated visual amenity
Medium	The proposal represents a moderate intrusion into the available vista and is a readily noticeable element. A noticeable degree of visual change will occur within the scene perceptibly altering its character, composition and associated visual amenity
Low	The proposal intrudes to a minor extent into the available vista and may not be noticed by a casual observer and/or the proposal would not have a marked effect on the visual amenity of the scene
Negligible	The proposal would be barely discernible within the available vista and/or it would not influence the visual amenity of the scene

Table 4.4 Magnitude of Visual Impacts

4.2.8.4. Visual Impact Significance

As stated above, the significance of visual impacts is a function of visual receptor sensitivity and visual impact magnitude. This relationship is expressed in the significance matrix in Table 4.3 above.

4.2.8.5. Quality of Effects

In addition to assessing the significance of landscape/townscape effects and visual effects, EPA Guidance requires that the quality of the effects is also determined. This could be negative/adverse, neutral, or positive/beneficial.

- Positive Effects: A change which improves the quality of the environment.
- Neutral and/or balanced Effects: No effects, or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
- Negative/adverse Effects: A change that reduces the quality of the environment.

4.2.9. Assessment Criteria for Cumulative Effects

The NatureScot Guidance relating to 'Assessing the Cumulative Effects of Onshore Wind Farms (2021) identify that cumulative impacts on visual amenity consist of combined visibility and sequential effects. The same categories have also been adopted in the Landscape Institute's 2013 revision of the Landscape and Visual Impact Assessment Guidelines. The principal focus of wind energy cumulative impact assessment guidance relates to other wind farms - as opposed to other forms of development. This will also be the main focus herein, albeit with a subsequent consideration of cumulative impacts with other forms of notable development (existing, permitted or proposed), particularly within the Central Study Area.

'Combined visibility occurs where the observer is able to see two or more developments from one viewpoint. Combined visibility may either be in combination (where several wind farms are within the observer's arc of vision at the same time) or in succession (where the observer has to turn to see the various wind farms).

Sequential effects occur when the observer has to move to another viewpoint to see different developments. The occurrence of sequential effects may range from frequently sequential (the features appear regularly and with short time lapses between, depending on speed of travel and distance between the viewpoints) to occasionally sequential (long time lapses between appearances, because the observer is moving very slowly and / or there are large distances between the viewpoints.)'

Cumulative impacts of wind farms tend to be adverse rather than positive as they relate to the addition of moving manmade structures into a landscape and viewing context that already contains such development. Table 4.5 below provides Macro Works' criteria for assessing the magnitude of cumulative impacts, which are based on the Naturescot Guidelines (2021).

Magnitude of Impact	Description
Very High	• The proposed wind farm will strongly contribute to wind energy development being the defining element of the surrounding landscape. • It will strongly contribute to a sense of wind farm proliferation and a sense of being surrounded by wind energy development. • Strongly adverse visual effects will be generated by the proposed turbines in relation to other turbines.
High	• The proposed wind farm will contribute significantly to wind energy development being a defining element of the surrounding landscape. • It will significantly contribute to a sense of wind farm proliferation and being surrounded by wind energy development. • Significant adverse visual effects will be generated by the proposed turbines in relation to other turbines.
Medium	• The proposed wind farm will contribute to wind energy development being a characteristic element of the surrounding landscape. • It will contribute to a sense of wind farm accumulation and dissemination within the surrounding landscape. • Adverse visual effects might be generated by the proposed turbines in relation to other turbines.

Low	• The proposed wind farm will be one of only a few wind farms in the surrounding area and will be viewed in isolation from most receptors. • It might contribute to wind farm development becoming a familiar feature within the surrounding landscape. • The design characteristics of the proposed wind farm accord with other schemes within the surrounding landscape and adverse visual effects are not likely to occur in relation to these.
Negligible	• The proposed wind farm will most often be viewed in isolation or occasionally in conjunction with other distant wind energy developments. • Wind energy development will remain an uncommon landscape feature in the surrounding landscape. • No adverse visual effects will be generated by the proposed turbines in relation to other turbines.

Table 4.5 Magnitude of Cumulative Impacts

4.3. Baseline Conditions

4.3.1. Landscape Baseline

The landscape baseline represents the existing landscape context and is the scenario against which any changes to the landscape brought about by the proposal will be assessed. This also includes reference to any relevant landscape character appraisals and the current landscape policy context (both are generally contained within County Development Plans).

A description of the landscape context of the proposed site and Wider Study Area is provided below under the headings of landform and drainage, vegetation and land use, centres of population, transport routes and public amenities and facilities as well as the immediate site context. Additional descriptions of the landscape, as viewed from each of the selected viewpoints, are provided under the detailed assessments later using a similar structure. Although this description forms part of the landscape baseline, many of the landscape elements identified also relate to visual receptors i.e. places and transport routes from which viewers can potentially see the proposed development. The visual resource will be described in greater detail below.

4.3.2. Landform and Drainage

The site is located to the north of a pair of summits which measure 134m and 183m, while the surrounding landform trends generally downhill towards Lough Corrib to the east, and upwards to the north/west. To the west, these areas are punctuated with evenly distributed, frequent small loughs and connecting waterways. To the northeast, continuous rolling bog is backed by upland areas to the far north (outside of the study area), while the south west transitions into coastal bog and marginal farmland with frequent small loughs that blend seamlessly with the intricate inlets and islands of the Connemara coastline. Further south, broad undulating area of hill country with numerous loughs and rivers, drains towards the northern coast of Galway Bay (Cois Fharraige) which runs in a uniform east/west manner across the southern section of the study area. The northeast of the study area is defined by the far shoreline of Lough Corrib, while the southeast features the lower sections of the lough as it narrows and flows to the head of Galway Bay. At the periphery of the study area along these shorelines, the subtle undulations and complex Lough shoreline are of a finer scale than the southwestern half of the study area.

Generally, the study area can be divided approximately in half from northwest to southeast. This division aligns over the western shores/extents of Lough Corrib and Ross, where the southeast is a transition from uplands to bog, to coast. In contrast, the north-eastern section transitions over rolling landform to Lough Corrib, over the lake, to the far shore and then into the generally more subtle rolling landform further inland.

4.3.3. Vegetation and Land Use

The vegetation and land use follows the varied topography of the study area. Divided generally northwest/southeast, aligned with the southern shores of Lough Corrib/Ross Lake, and the N59 road corridor. Throughout the north-eastern Lake and farmland context, shoreline and peninsula farmland mixes with riparian scrub and woodland and is dotted with rural residences and holiday homes vying for lake views. The far north of the study area is the transition between Lough Corrib and the mountainous areas to the northwest, with a generally naturalistic land cover of blanket bog or exposed rock and scree slopes with occasional blocks of commercial conifer plantation on mid slopes then giving way to valley farmland. The southwest is predominantly contained in coastal peat bog with very occasional patches of forest plantation and farmland where drainage allows. Finally, the south of the site shares similar land cover characteristics to the site, is contained in a combination of naturalistic moorland and large conifer plantations before transitioning to sloping farmland and a dense cover of holiday homes and farm residences along the coast of Galway Bay/ Cois Fharraige. Of particular note is that the central west of the study area has also become synonymous with wind energy developments (Galway Wind Park) in recent decades and numerous turbines are contained within predominantly the forested areas. The one outlier of this pattern is the dense concentration of built and urban form surrounding Galway city at the southeast border of the study area, at the narrowest point between the large waterbodies which define the study area (Galway Bay and Lough Corrib).

4.4. Landscape Policy Context and Designations

4.4.1. The Department of Environment, Heritage and Local Government Wind Energy Development Guidelines (2006)

The Wind Energy Development Guidelines (2006) provide guidance on wind farm siting and design criteria for a number of different landscape types. The site of the proposed development is considered to be located within a relatively complex landscape setting that is most consistent with the 'Transitional Marginal Landscape' type from the Wind Energy Development Guidelines. However, the wider context does encompass characteristics from a mix of the landscape types including, 'Mountain Moorland,' 'Hilly and Flat Farmland' and 'Flat Peatland.'

The most relevant recommendations for the 'Transitional Marginal' Landscape type is set out below, but with consideration of the guidance relating to other relevant landscape types considered thereafter.

Transitional Marginal Landscapes:

Location -

"As wind energy developments, for reasons of commercial viability, will typically be located on ridges and peaks, a clear visual separation will be achieved from the complexity of lower ground."

"wind energy developments might also be located at lower levels in extensive areas of this landscape type, where they will be perceived against a relatively complex backdrop. In these situations it is important to minimise visual confusion such as the crossing by blade sets of skylines, buildings, utility lines and varied landcover."

Spatial extent –

"Wind energy developments in these landscapes should be relatively small in terms of spatial extent. It is important that they do not dominate but achieve a balance with their surrounds, especially considering that small fields and houses are prevalent."

"4(a)Wind energy development with regular spacing and linear layout – may not be appropriate due to the undulation of the land from as well as limited field pattern."

"4(b)Wind energy development with irregular spacing and random layout -is more appropriate given the relative undulation of the setting."

"4(c)Large wind energy development straddling two landscape character types within the same visual unit can create visual ambivalence and, thus, negative tension between the two character types involved."

Spacing -

"All options are possible, depending on the actual landscape characteristics. However, irregular spacing is likely to be most appropriate."

Layout -

"The likely location of wind energy developments on ridges suggests a linear or staggered linear layout whereas on broader hilltops they could be linear or clustered."

Height -

"…where the upper ground is relatively open and visually extensive, taller turbines may be more appropriate."

"…the profile can be even or uneven, depending on the profile and visual complexity of the terrain involved. The more rugged and undulating, the greater the acceptability of an uneven profile provided it does not result in significant visual confusion and conflict."

Cumulative –

"This would have to be evaluated on a case-by-case basis, but great caution should be exercised. The spatial enclosure often found in transitional marginal landscapes is likely to preclude the possibility of seeing another wind energy development. However, should two or more wind energy developments be visible within a confined setting a critically adverse effect might result, depending on turbine height and wind energy development extent and proximity."

Most design options appear to be appropriate for 'Transitional Marginal Landscapes' and vary depending on the specific site. In respect of the above guidance, the modest spatial extent of the proposed development is in keeping with that recommended for transitional marginal (contained), as well as the recommendation for mountain moorland that 'spatial extent of a wind energy development would need to be reduced where a suggestion of smaller scale is provided by nearby landscape features', as there is some enclosure provided by land form and vegetation.

The layouts recommended for these landscape types are random for mountain moorland, where there are no linear features to relate to, for transitional landscapes, the assumption is that they will be located on ridges, which is not wholly the case for this proposal. Therefore, the alternative recommendation is 'clustered' and this is the approach that has been taken in this instance.

4.4.2. Galway County Development Plan (2022 – 2028)

The new landscape character assessment prepared for incorporation within the recently adopted Galway County Development Plan re-classifies and zones the landscape at three scales and then applies landscape sensitivity ratings.

Landscape Regions – a broad area of land with a distinctive character due to large-scale natural factors – such as mountains, plains, coasts etc.

Landscape Character Type – an area of land that has an appearance that is readily recognisable as being different and distinctive from other areas.

Landscape Character Unit – the smallest area of distinctive local features within a Landscape Type that can be practicably identified to assist in policy formulation.

The hierarchy of landscape units and those most relevant to the site and Wider Study Area are identified in Table 4.6 below.

Landscape Region	Landscape Type	Landscape Character Unit (in 20km Study Area)
West Galway	1. Coastal	1b. Cois Fharraige
		1c. Inner Galway Bay
		1f. Conamara Sea Lough
	3. Uplands and Bog Landscape	3b. Maumturk Mountains
		3c. West Connemara
		3d. South Connemara
	4. Lake Environs Landscape	4a. Upper Corrib Environs
		4b. Lower Corrib Environs
Eastern Plains	6. Central Galway Complex Landscape	6a. Black River Basin Unit
		6b. Southern River Clare Basin
	7. Urban Environs Landscape	

Table 4.6 Relevant Landscape Units and Hierarchy

4.4.2.2.Landscape Region

As above, the landscape region is the largest scale which the County has been divided into. The region which the proposal is located in the West Galway Region, defined as 'a zone that is mostly underlain by older harder geology that gives rise to large-scale rugged, complex landscapes of mountains, lakes, bogs, islands and coastal inlets in the western parts of the county.' This region is the entirety of the County located west of Headford/Galway/the eastern extent of Lough Corrib, except for an off-set along the coastline, which is the Coastal region. To the north the region is defined by the border with Co. Mayo.

4.4.2.3.Landscape Types

The landscape regions have been further broken down into ten separate landscape types. The Landscape Character Types for County Galway are as follows:

2.3.3. Upland and Bog Landscape Type

A large area of very open landscape with dispersed settlements, roads and agriculture. The extensive areas of exposed rock, uplands and blanket bog are largely unenclosed. There are large areas of coniferous forestry plantation in a number of locations away from the coast. It has two principal components that are contained between a complex coastal mosaic of sea inlets to the west and south, and the long shore of Lough Corrib to the east. The first component is the steep-sided peaks of the 12 Bens that run west-east south of Killary Harbour and the other is a large lake-studded plain of blanket bogs. The overall landscape is valued on account of the scale of the open views within this unenclosed landscape. Another perceived value is the contrast between the uninterrupted and uninhabited plains. Open areas around bogs reveal extensive sky views and the area contains expanses of dark sky. The area is extensively used for hill-walking and recreational touring by coach, cars and cycles. It also contains the Connemara National Park.

4.4.2.4.Landscape Units

The landscape character types are then split into landscape character units. The site is located within Character Unit 3d. South Connemara, which is defined as:

"Extensive plateaux of blanket bog, small lakes and extensive forestry. Largely un-enclosed and unoccupied."

4.4.2.5.Landscape Sensitivity

Section 8.13.2. Landscape Sensitivity, of the County Development Plan defines Landscape Sensitivity as:

"A landscape's capacity to absorb new development, without exhibiting a significant alteration of character or change of appearance is referred to as it's 'sensitivity'. This depends on factors such as elevation, slope, as well as the types of land-cover and soil. The area is classified as being increasingly sensitive as more of these factors are present in the same place."

The Landscape Character Assessment for the county has outlined four separate Landscape Sensitivities as follows:

"Class–1 - Low: Unlikely to be adversely affected by change

Class–2 - High: Elevated sensitivity to change

Class–3 - Special: High sensitivity to change

Class–4 - Iconic: Unique Landscape with high sensitivity to change"

The site is located within a 'High' Landscape Sensitivity classification.

4.4.2.6.Landscape Policies

Within the Galway County Development Plan, the following policies apply to landscape.

Policy Objectives Landscape Conservation and Management

LCM 1 Preservation of Landscape Character - Preserve and enhance the character of the landscape where, and to the extent that, in the opinion of the Planning Authority, the proper planning and sustainable development of the area requires it, including the preservation and enhancement, where possible of views and prospects and the amenities of places and features of natural beauty or interest.

LCM 2 Landscape Sensitivity Classification - The Planning Authority shall have regard to the landscape sensitivity classification of sites in the consideration of any significant development proposals and, where necessary, require a Landscape/Visual Impact Assessment to accompany such proposals. This shall be balanced against the need to develop key strategic infrastructure to meet the strategic aims of the plan.

LCM 3 Landscape Sensitivity Ratings - Consideration of landscape sensitivity ratings shall be an important factor in determining development uses in areas of the County. In areas of high landscape sensitivity, the design and the choice of location of proposed development in the landscape will also be critical considerations.

4.4.2.7.Scenic Amenity Policies and Designations

The Galway County Development Plan contains an update to the previous scenic designations map. Scenic route and scenic views are identified in separate maps. In relation to scenic routes the Galway County Development Plan states;

Scenic Routes

A scenic route is not and cannot be a comprehensive protection for the entire landscape. It does provide an instrument for predicting and assessing representative measurement of what effects would be experienced. by the majority of potential public viewers in the majority of circumstances.

There are three Scenic Routes that are considered relevant to the Proposed Development. These include;

Maritime Scenic Route, Maum Valley Scenic Route, Lough Corrib Scenic Route, Galway Clifden Scenic Route and the Galway Bay Scenic Route. The nearest to the site are the Galway (to/from) Clifden and Lough Corrib Scenic Routes. Of these, the Galway Clifden Route is focused on the receiving landscape of the proposal. Within the CDP Landscape Character Assessment, this is grouped with the Sraith Salach Letterfrack & Maum Valley Scenic Routes and described as follows:

"These routes are described together because they provide alternative routes through the same large area– the Upland and Blanket Bog - which is one of Ireland's most distinctive landscapes. They range from the outskirts of Oughterard to either Clifden or Letterfrack – with a further variation of the Maum Valley link. For the majority of each route the landscape is open and largely devoid of visible development. It offers expansive views of uplands, bogs and lakes.

The landscapes are very large and expansive – drawing the eye to distant horizons and to the ever-changing sky. The turbulent Atlantic frontal weather systems cause the lighting to frequently change. Seasons bring about large-scale changes of colour –both of vegetation and grasses.

Key Features: Mountains, Lakes, Bogs."

Protected Views

Protected views are shown in Map 8.4 of the CDP, where the direction and included angle for each is indicated.

Views relevant to the project (within the Study Area) as derived from LCA Table 6.4 Schedule of Protected Views are indicated in Table 4.7 below.

View Number and Location	Field of view (FOV)	Relative Site Location (within/outside of FOV) and Predicted Theoretical Visibility (ZTV)
20 North Lough Corrib	180	Outside of FOV and ZTV

21 The Quiet Man Bridge	30	Outside of FOV and ZTV
23 An Charraig Thoir	150	***Inside FOV and ZTV***
24 Western Way High Road	150	*Outside of FOV, within ZTV*
25 Views of Islands on Lough Corrib	40	Outside of FOV and ZTV
26 Spidéal Cósta	120	Outside of FOV and ZTV
27 Ard na Goaithe	150	***Inside FOV and ZTV***
28 Oughterard Pier	180	*Outside of FOV, within ZTV*
29 View of North Clare coast	180	Outside of FOV and ZTV
30 View of the sea from Bearna	180	Outside of FOV and ZTV
31 Kilbeg Pier	180	***Inside FOV and ZTV***
32 Silver Strand	180	Outside of FOV and ZTV
33 Friary of Ross	30	*Outside of FOV, within ZTV*

Table 4.7 Relevant Scenic Views

Relevant scenic amenity policy includes;

PVSR 1 – Protected Views and Scenic Routes

Preserve the protected views and scenic routes as detailed in Maps 8.3 and 8.4 from development that in the view of the Planning Authority would negatively impact on said protected views and scenic routes. This shall be balanced against the need to develop key infrastructure to meet the strategic aims of the plan.

4.4.2.8.Local Authority Renewable Energy Strategy (LARES)

A new Local Authority Renewable Energy Strategy has been prepared for County Galway using guidance from the Sustainable Energy Authority of Ireland (SEAI) and it is stated that *"The LARES replaces the Wind Energy Strategy of the Galway County Development Plan 2015 (as varied)."*

Section 14.8.1 Local Authority Renewable Energy Strategy

To facilitate the sustainable growth of renewable energies a Local Authority Renewable Energy Strategy (LARES) has been prepared for the county as part the plan and is included in Appendix 1. The LARES' outlines the renewable energy resource potential in the county and it is a strategic aim to ensure that such developments are suitably located, economical and sustainable in the long term. The Strategy has been prepared taking account of relevant European, national, regional and local planning frameworks and guidelines.

Policy Objective Renewable Energy (RE) 3 Wind Energy Developments

Promote and facilitate wind farm developments in suitable locations, having regard to areas of the County designated for this purpose in the Local Authority Renewable Energy Strategy. The Planning Authority will assess any planning application proposals for wind energy production in accordance with the Local Authority Renewable Energy Strategy, the DoEHLG Guidelines for Planning Authorities on Wind Energy Development, 2006 (or any updated/superseded documents), having due regard to the Habitats Directive and to the detailed policy objectives and Development Standards set out in the Local Authority Renewable Energy Strategy.

In Chapter 15 of the Plan 'Development Management Standards', the following standards apply to Wind Energy

15.13.3 Renewable Energy Proposals, DM Standard 70: Wind Energy

When assessing planning applications for wind energy developments the Council will have regard to;

- the Wind Energy Development Guidelines for Planning Authorities, DoEHLG, (2006) and any amendments to the Guidelines which may be made; and
- the Local Authority Renewable Energy Strategy;

In addition to the above, the following local considerations (relevant to landscape) will be taken into account by the Council in relation to any planning application;

- Impact on the visual amenities of the area;
- Impact on the residential amenities of the area:
- Scale and layout of the project, any cumulative effects due to other projects and the extent to which the impacts are visible across the local landscape;
- Visual impact of the proposal with respect to protected views, scenic routes and sensitive landscapes (Class 2, 3 and 4);

The key points from the above are the presence of sensitive landscapes and views within the immediate Study Area. The site is generally located within 'Strategic Area,' however, with the re-zoning which has occurred since the original application was permitted, the eastern area of the site now also overlays 'Not normally permissible' zoning on Map 15: Wind Potential from Appendix 1: LARES of the CDP (See Figure 4.1).

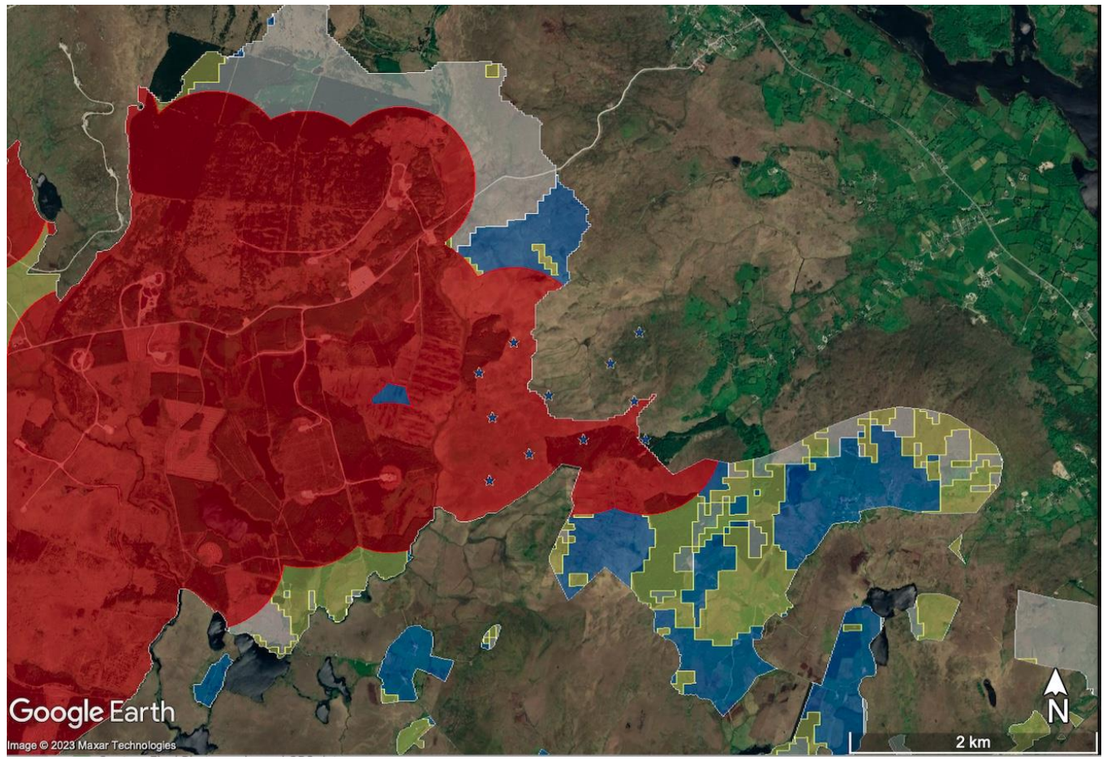

Figure 4.1 Wind Energy Potential zoning relative to the Permitted / Proposed wind farm layout (Blue stars) - Red pattern is Strategic Area, No pattern is Not Normally Permissible (by default)

Relevant Policy Objectives within the LARES include;

LARES Policy Objective 13 Wind Energy Generation

To increase renewable energy generation levels from wind energy developments in County Galway, given the recognised wind energy potential of the County.

LARES Policy Objective 14 National Wind Energy Guidelines

All onshore wind energy developments shall comply with the National Wind Energy Development Guidelines or any subsequent version thereof.

LARES Policy Objective 18 Not Normally Permissible

Wind energy development proposals in areas that are identified as 'Not Normally Permissible' for wind energy development will be considered in accordance with the LARES and the proper planning and sustainable development of the area.

Wind energy development proposals should consider the constraints and challenges detailed in Sections 5 and 9 of this LARES and should indicate how these constraints can be addressed where they are not located in an area identified as 'Strategic Areas' or 'Acceptable in Principle'. Although wind energy developments located in areas identified as 'Strategic Areas' or 'Acceptable in Principle' will be considered favourably, they will still need to be assessed against the policies and provisions of the Wind Energy Guidelines, the County Development Plan and any other relevant policy documents.

4.5. Visual Baseline

Only those parts of the Study Area that potentially afford views of the Proposed Development are of interest to this part of the assessment. Therefore, the first part of the visual baseline is establishing a 'Zone of Theoretical Visibility' and subsequently, identifying important visual receptors from which to base the visual impact assessment (See ZTV map – Appendix 4.2).

4.5.1. Zone of Theoretical Visibility (ZTV)

A computer generated Zone of Theoretical Visibility (ZTV) map has been prepared to illustrate where the proposed development is 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.

In terms of the overall visual exposure of the turbines to receptors within the surrounding landscape, a comparative Zone of Theoretical visibility (ZTV) map has been prepared (see Appendix 4.3). This identifies parts of the 20km radius LVIA study area that would have a potential view of the permitted turbines as well as the proposed turbines, with the difference (blue pattern) being those areas that would only see the latter (in a bare-ground scenario). The comparative ZTV map indicates an increase of 2.3% in the area of land that will have a view of the proposed turbine blade tips, but not the currently permitted blade tips (blue pattern at the fringe of the magenta pattern). The most noticeable areas where this theoretical increase in visual exposure occurs are the transition along the N59 from the bog to Lough Corrib landscape, and the visibility over the coastal border and open ocean over Galway Bay in the south of the study area. Otherwise, there are scattered sections over the southern section of the study area – the landscape currently dominated by rolling bog and existing wind farm development. This is a fractional and theoretical increase to visual exposure that has no material consequence for visual receptors within the study area.

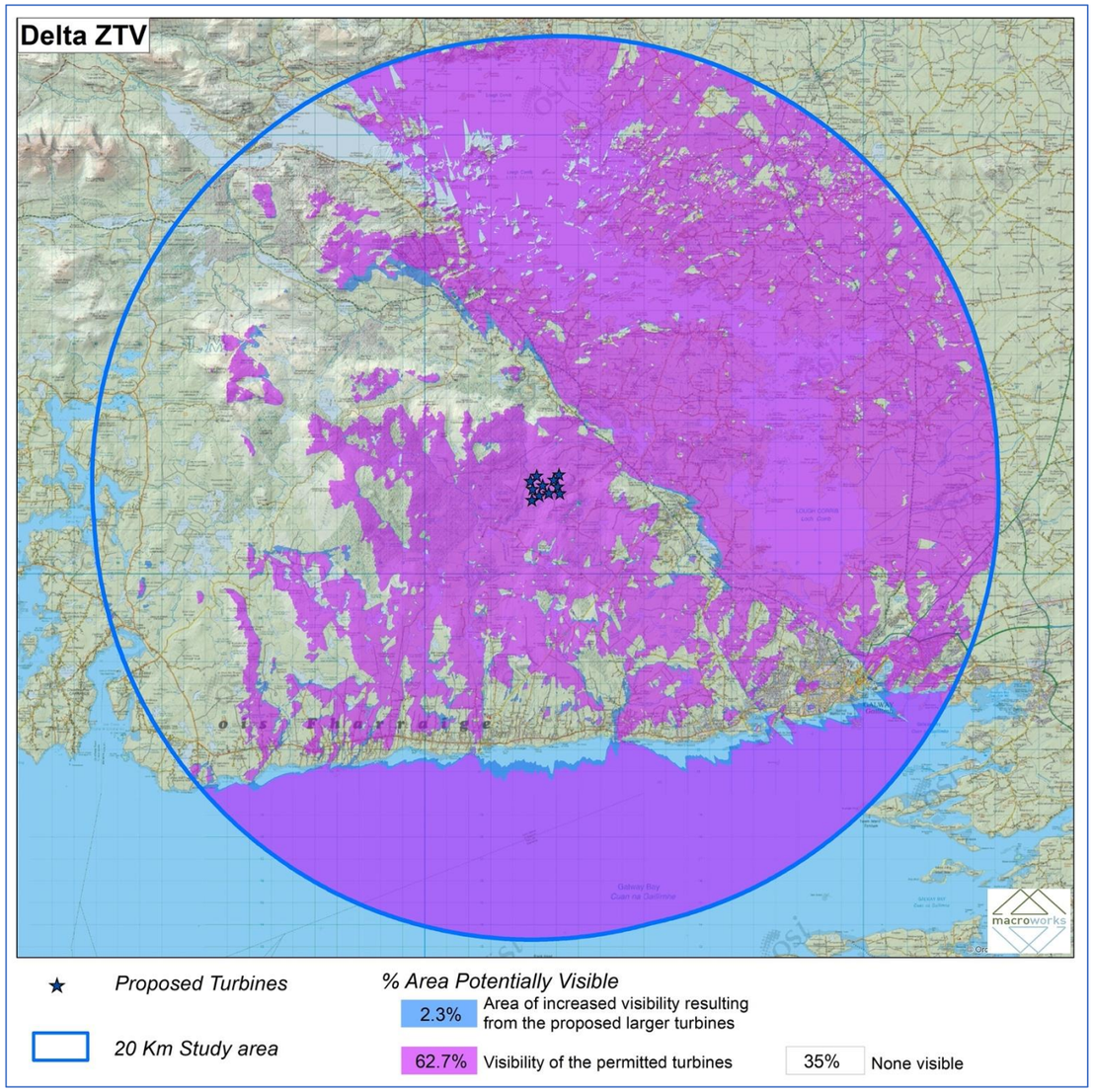

Figure 4.2 Comparative Zone of Theoretical Visibility (See Appendix 4.3 for larger scale map)

4.5.2. Views of Recognised Scenic Value

Views of recognised scenic value are primarily indicated within County Development Plans in the context of scenic views/routes designations, but they might also be indicated on touring maps, guidebooks, road side rest stops or on post cards that represent the area. The relevant scenic designations contained in the Galway County Development Plan have been identified above in 'Landscape Policy Context and Designations.'

All of the scenic routes and views that fall inside the ZTV pattern were investigated during fieldwork to determine whether actual views of the Proposed Development might be afforded. Where visibility may occur, a viewpoint has been selected for use in the visual impact appraisal later in this chapter.

View Number and Location	Relevance to Visual Impact Appraisal	VRP No.
23 An Charraig Thoir	***Inside FOV and ZTV***	VP1 (Representative)
24 Western Way High Road	*Outside of FOV, within ZTV*	VP5
27 Ard na Goaithe	***Inside FOV and ZTV***	VP1 (Representative)
28 Oughterard Pier	*Outside of FOV, within ZTV*	VP5 (Representative)
31 Kilbeg Peir	***Inside FOV and ZTV***	VP2/VP3 (Representative)
33 Friary of Ross	*Outside of FOV, within ZTV*	VP2/VP3 (Representative)
Maritime Scenic Route	*Low/Partial ZTV, views not directed towards the site*	N/A
Lough Corrib Scenic Route	*Partial ZTV, Lough Corrib views directed away from site*	VP6, VP13, VP14
Galway Clifden Scenic Route	***Partial ZTV, focused on open bog landscape***	VP6, VP13, VP14
Maum Valley Scenic Route	*Outside ZTV, views not directed towards the site*	N/A

Table 4.8 Rational for representative views of Galway scenic designations

4.5.3. Centres of Population and Houses

The largest centre of population in the Study Area is Galway City, the periphery of which (as per the CDP Landscape Assessment) is located10km southeast of the site. Within the Landscape Character Assessment, there are 'Urban Environs Landscape' areas identified. Of these, 5 are within the study area: Oughterard (8.5km from the nearest turbine), Moycullen (5km east/southeast), Spiddal (11km south), Bearna (12.6km southeast), and Headford (16.3km northeast).

There are a number of smaller settlements and service centres in the Wider Study Area, as well as a distributed rural population, of higher density surrounding the borders of Lough Corrib to the north/east of the study area, and Galway Bay/Atlantic Coast to the south/west. There are clusters of residences at Doon West (2.5km northeast), Rosscahill (3.7km northeast), but the density of houses is fairly consistent over the lower, greener landscapes along the N59 corridor between Moycullen and Oughterard, northeast to the border of Lough Corrib. The same is true along the northern boundary of Galway Bay, in the south of the study area. The R336 is almost continuously bordered by standalone residences, from Galway City to the edge of the study area at Rossaveel. In contrast, the Central Study Area (and wider area triangulated between the R336, N59 and study area border), is sparsely populated. There are tendrils of development which extend towards the site, in particular from the north/east and N59, but the generally reduces westwards into the areas dominated by existing wind farm development.

4.5.4. Transport Routes

The densest concentration of transport routes is at the southeast edge of the study area, where the N59, N84, N83, N6, as well as the R338, R337, R336, R866, R865, R864 intersect around Galway. The most influential transport route over the study area is the N59, which runs in a general southeast/northwest direction along Lough Corrib from Galway, it is 2.5km to the south at its nearest point. There are regional roads connecting the community around the perimeter of the lake, to the main centres beyond the Study Area. In the west of the Study Area, the R336 crosses the N59 at right angles, running north/south at Maam Cross. This (the R336) connects with the R345 at the north-western extent of Lough Corrib. The R346 connects to the R334 to continue south around the lake towards the N84 which is the mirror of the N59, on the opposite (northeast) side of the study area. As noted in the centres of population section, the receiving landscape of the site is located between the triangle created by the N59/ R336, as they follow the Lough Corrib and the coastline. There are two local roads which diverge off the N59 in a perpendicular manner (heading southwest), one from Moycullen (L1320), one from (L1311). There are other minor local roads which radiate inwards from the main corridors, however these rarely extend more than 4km into the bog.

4.5.5. Tourism, Recreational and Heritage Features

There are a range of tourism, recreational and heritage features throughout the Study Area and this is a popular area for both international and domestic visitors. The north and west of the study area in particular is an area that has become somewhat synonymous with a nostalgic view of 'Old Ireland' and much of the tourist draw relates to this perception. One such location is the 'Quiet Man Bridge' between Lough Boffin and Lough Agraffard, which is associated with the 1952 movie 'The Quiet Man' starring John Wayne and Maureen O'Hara. This is located 12.6km northwest of the nearest turbine and is a popular photo location for people posing in the same manner as the movie, with the landscape behind them.

Continuing west of the site, the Screebe Fisherman's Hut is another, more local scenic location and visitor attraction, located along the R336. The Wild Atlantic Way (WAW) crosses the Study Area around the coast between Screebe and Galway, entering the study area to the west at the intersection of the R340 and R336. There are a number of WAW points across the study area, these are as follows:

- Trá na gCeann /Silver Strand (13.7km SE)
- Bóthar na Trá /Salthill Promenade (15.2km SE)
- Seanchéibh an Spidéil/ Spiddal Harbour (11.4km S/SW)
- Ballynahown Pier/Cartron Harbour (19.5km SW)

Around the southern (near) shore of Lough Corrib towards Oughterard, there are multiple walks within the conifer plantations, and smaller settlements clustered around bays with stone wharfs, used recreationally for boating and swimming. Oughterard, Moycullen, and in particular Galway City features a variety of attractions, both nature based and heritage based. To the east of the site is Ross Lake and Ross Castle/Demesne, which looks across Ross Lake to the west.

On the far (north/northeast) shore of Lough Corrib, Cong (marginally outside of the study area) features a variety of attractions, tourism, recreational and heritage. Ashford Castle is located at the mouth of the River Cong, as is the Ard Na Gaoithe, Forest Recreational Park Further around the eastern shore of Lough Corrib, there is a dispersed collection of viewpoints and features, generally focused on harbours, jettys and other lakeside structures. This density of use and minor attractions is continuous around the perimeter of the Lough.

4.6. Identification of Viewshed Reference Points as a Basis for Assessment

The results of the ZTV analysis provide a basis for the selection of Viewshed Reference Points (VRP's), which are the locations used to study the landscape and visual impact of the proposed wind farm in detail. It is not warranted to include each and every location that provides a view of this development as this would result in an unwieldy report and make it extremely difficult to draw out the key impacts arising from the project. Instead, a variety of receptor locations was selected that are likely to provide views of the proposed wind farm from different distances, different angles and different contexts.

The visual impact of a proposed development is assessed using up to 6 categories of receptor type as listed below:

- Key Views (from features of national or international importance);
- Designated Scenic Routes and Views;
- Local Community views;
- Centres of Population;
- Major Routes; and
- Amenity and heritage features.

Where a VRP might have been initially selected for more than one reason it will be assessed according to the primary criterion for which it was chosen. The characteristics of each receptor type vary as does the way in which the view is experienced. These are described below.

Key Views

These VRPs are at features or locations that are significant at the national or even international level, typically in terms of heritage, recreation or tourism. They are locations that attract a significant number of viewers who are likely to be in a reflective or recreational frame of mind, possibly increasing their appreciation of the landscape around them. The location of this receptor type is usually quite specific.

Designated Scenic Routes and Views

Due to their identification in the County Development Plan this type of VRP location represents a general policy consensus on locations of high scenic value within the Study Area. These are commonly elevated, long distance, panoramic views and may or may not be mapped from precise locations. They are more likely to be experienced by static viewers who seek out or stop to take in such vistas.

Local Community Views

This type of VRP represents those people who live and/or work in the locality of the proposed EIA Development, usually within a 5km radius of the site. Although the VRPs are generally located on local level roads, they also represent similar views that may be available from adjacent houses. The precise location of this VRP type is not critical; however, clear elevated views are preferred, particularly when closely associated with a cluster of houses and representing their primary views. Coverage of a range of viewing angles using several VRPs is necessary in order to sample the spectrum of views that would be available from surrounding dwellings.

Centres of Population

VRPs are selected at centres of population primarily due to the number of viewers that are likely to experience that view. The relevance of the settlement is based on the significance of its size in terms of the Study Area or its proximity to the site. The VRP may be selected from any location within the public domain that provides a clear view either within the settlement or in close proximity to it.

Major Routes

These include national and regional level roads and rail lines and are relevant VRP locations due to the number of viewers potentially impacted by the Proposed Development. The precise location of this category of VRP is not critical and might be chosen anywhere along the route that provides clear views towards the Site, but with a preference towards close and/or elevated views. Major routes typically provide views experienced whilst in motion and these may be fleeting and intermittent depending on screening by intervening vegetation or buildings.

Tourism, Recreational and Heritage Features

These views are often one and the same given that heritage locations can be important tourist and visitor destinations and amenity areas or walking routes are commonly designed to incorporate heritage features. Such locations or routes tend to be sensitive to development within the landscape as viewers are likely to be in a receptive frame of mind with respect to the landscape around them. The sensitivity of this type of visual receptor is strongly related to the number of visitors they might attract and, in the case of heritage features, whether these are discerning experts or lay tourists. Sensitivity is also heavily influenced by the experience of the viewer at a heritage site as distinct from simply the view of it. This is a complex phenomenon that is likely to be different for every site. Experiential considerations might relate to the sequential approach to a castle from the car park or the view from a hilltop monument reached after a demanding climb. It might also relate to the influence of contemporary features within a key view and whether these detract from a sense of past times. It must also be noted that the sensitivity rating attributed to a heritage feature for the purposes of a landscape and visual assessment is not synonymous with its importance to the Archaeological or Architectural Heritage record.

The Viewshed Reference Points selected in this instance are set out in Table 4.10 below and shown on the VP selection Map in the Photomontage Booklet.

VP No.	Location	Distance to site (km)	Direction of view
VP1	R345 at Carrowkeel	20.2	S
VP2	Inchiquin Island	11.7	SW
VP3	Luimnagh - NE Lough Corrib	15	W
VP4	N84 at Carrowbrowne	16	W
VP5	Section of Western Way Walking Trail	11.6	S
VP6	N59 South of Roscahill	3.7	SW
VP7	Ross Demesne	3.5	SW
VP8	Crossroads North of Cloonabinna	5.2	W
VP9	Letter Road 2km South-West of Doon	1.4	S
VP10	Local Cnocan Raithní	1.8	SW
VP11	Local Road at Oghery	1.5	W
VP12	Local road East of Knockranny Hill	2.3	W
VP13	N59 South of Knockranny junction	3	W
VP14	Newton Schoolyard along N59	3.2	W
VP15	Tumnasrah	8.1	W
VP16	Tullaghnanoon	2	N
VP17	Crossroad to Finisklin	4.7	N
VP18	Leitirpeak	6.1	N
VP19	Shannapheisteen	9.2	E
VP20	Inis Mór	37	NE
VP21	Local Road southeast of the site at Pillagh	1.6	NW

Table 4.9 Rational Outline description of selected Viewshed Reference Points (See also VP location map (Appendix 4.4)

4.7. Cumulative Baseline

The NatureScot Guidelines relating to the Cumulative Effects of Wind Farms (2021) and GLVIA - 2013 identify that cumulative impacts on visual amenity consist of combined visibility and sequential effects. The same categories have also been adopted in the Landscape Institute's 2013 revision of the Landscape and Visual Impact Assessment Guidelines:

> *"Combined visibility occurs where the observer is able to see two or more developments from one viewpoint. Combined visibility may either be in combination (where several windfarms are within the observer's arc of vision at the same time) or in succession (where the observer has to turn to see the various windfarms).*
>
> *Sequential effects occur when the observer has to move to another viewpoint to see different developments. The occurrence of sequential effects may range from frequently sequential (the features appear regularly and with short time lapses between, depending on speed of travel and distance between the viewpoints) to occasionally sequential (long time lapses between appearances, because the observer is moving very slowly and / or there are large distances between the viewpoints.)"*

Cumulative impacts of windfarms tend to be adverse rather than positive, as they relate to the addition of moving manmade structures into a landscape and viewing context that already contains such development. Based on guidance contained within the NatureScot Guidelines relating to the Cumulative Effects of Wind Farms (2021) and the DoEHLG Wind Energy Guidelines (2006), cumulative impacts can be experienced in a variety of ways.

> *"Where an existing windfarm is already prominent on a skyline the introduction of additional structures along the horizon may result in development that is proportionally dominant. The proportion of developed to non-developed skyline is therefore an important landscape consideration."*

In terms of visual amenity, there is a range of ways in which an additional windfarm might generate visual conflict and disharmony in relation to other wind energy developments. Some of the most common include visual tension caused by disparate extent, scale or layout of neighbouring developments. A sense of visual ambivalence might

also be caused by adjacent developments traversing different landscape types. Turbines from a proposed windfarm that are seen stacked in perspective against the turbines of nearer or further developments tend to cause visual clutter and confusion. Such effects are exacerbated when, for example, the more distant turbines are larger than the nearer ones and the sense of distance is distorted. Table 4.5 above provides criteria for assessing the magnitude of cumulative impacts.

Wind Farm Name	Number of Turbines	Distance/direction relative to site (nearest turbine)	Status
Ardderroo Wind Farm	25	adjacent	Under construction
Inverin	5	10.4km SW	Existing
Galway Wind Park - Cloosh	22 Consented 20 Constructed	4.3km west	Existing
Galway Wind Park - Uggool	16 Constructed	2.6km northwest	Existing
Galway Wind Park - Seecon	23 Consented 16 Constructed	5.2km southwest	Existing
Galway Wind Park - Lettercraffroe	8 Constructed	7.3km northwest	Existing
Knockalough Wind Farm	11	3km south	Existing
Leitir Gungaid (Lettergunnet)	10	6.9km south-southeast	Existing
Letterpeck (Shannagurran & Truskaunngappul)	7	5.3km south	Existing

Table 4.10 Cumulative Wind Farms for consideration (refer to Chapter 1 for full details and planning references)

4.8. Assessment of Potential Effects

4.8.1. Do Nothing Scenario

In this instance the do-nothing effect would be that the permitted wind farm is constructed.

4.8.2. Landscape Impacts

Landscape impacts are assessed on the basis of landscape sensitivity weighed against the magnitude of physical landscape effects within the Site and effects on landscape character within the Central Study area and Wider Study area.

4.8.3. Landscape Character, Value and Sensitivity

Landscape value and sensitivity are considered in relation to a number of factors highlighted in the Guidelines for Landscape and Visual Impact Assessment 2013, which are set out below and discussed relative to the Central Study Area and Wider Study Area for the Proposed Development.

4.8.3.1. Central Study Area (<5km)

The Central Study Area features a rapid transition between different landscape characters. To the west and south, there is strong influence from Wind Energy generation/development, including the associated infrastructure of roads and substation. In between and below these, the overall landscape fabric is relatively consistent with the intervening landcover and landform, with the main vegetation type upland bog, with secondary cover of commercial forestry plantations. These landuses are overlaid with a network of minor waterways and chains of small loughs. The site is proposed within this landuse and landform, with a small introduction of more intensive landuse (farmland and rural residences) to the east. Access is limited across the central/west study area, with two local roads the only roads which transect east/west, one north and one south of the site. Both of these terminate at the N59 which runs north/south (northwest/southeast) along the northeast of the Central Study Area, defining the border between the upland bog/wind energy/forestry matrix landscape and the lowland farmland and lakeside areas. There are other local roads which run into the Central Study Area, but do not extend through the bog/forestry/wind areas to the opposite side of the Central Study Area. The densest concentration of roads, and associated intensification of landuse, is along the N59 corridor and extends to the northeast. Within this area, Ross Lake is a key area of amenity, including accommodation, recreational and amenity uses. This is also the largest area of woodland, over the subtle rolling landform surrounding Ross Lake, and separating it from Lough Corrib. Taking account of the varied nature of the receiving landscape, and the location of the site within the more robust character areas, it is considered that the Central Study Area has a general landscape sensitivity of **Medium**.

4.8.3.1. Wider Study Area (5-20km)

The Wider Study Area features similar patterns as the Central Study Area, with the key difference being the introduction of dramatic landform features, Lough Corrib and Galway Bay/ Cois Fharraige defining the landscape to the northeast and south, while the north is influenced by the upland mountainous areas outside of the study area. The western extent of the Study Area extends the base of the Connemara Mountains, which define the more northerly sections of the Study Area. The inland extent of the western study area is dominated by open, low vegetation and myriad of lakes scattered between rolling topography with a high proportion of exposed rock. The eastern border of this area is defined visually and physically by the area of relatively steep/elevated topography which runs approximately north/south between the R336 and the L1311 (Knocknasilloge Peak 400m). The faces of these rolling landforms are generally unmodified, creating a cohesive unit within the wider, western boglands. This landscape encompasses the sea lough complex that contains pockets of development and settlement to the southwest of the Study Area. While these loughs are generally similar to the surrounds in terms of vegetation cover and landform, the water bodies are saline and there is a slightly higher proportion of water to land as well as more legible bands of development around the shore and roads. The key element of this section of the Study Area is that it is the western extent of the iconic Connemara landscape, and the absence of structures and development is a key feature which contributes to its isolated and windswept character. This transitions southwards to the coast, where the landform and coastal setting becomes more uniform through to Galway City. As such, the landscape sensitivity is deemed **High**.

From the N59 corridor to the northeast, the majority of the Study Area is dominated by Lough Corrib itself, however, there are a myriad of islands and peninsulas throughout, which feature varying degrees of current and historic occupation. The steeper shorelines of the lakes, which relate to the mountains and hills to the west of the

Study Area feature higher degrees of vegetation and lower degrees of built form, aside from the relatively consistent presence of roads skirting the perimeter. Generally, this gives a high number of opportunities for scenic views and high amenity areas, with views along the water edge framed by the dramatic topography in the background. To the east, however, the density and level of development intensifies with a higher number of small roads and farm access roads networking the surrounding, flatter landscape. The vegetation cover is more intensely managed for agriculture, while pasture and hedgerows are dominant in the level areas, with more numerous and varied tree species and wild areas on the steeper section of rolling land closer to the water's edge. Given the relatively low proportion of both the Study Area, and the north/west extent of the Study Area which this landscape type covers, the sensitivity of this area will be based on the larger, more defined lakes and shoreline, with the consideration that there will be locally varied areas of sensitivity in the wider context. The lakes and waterways of the surrounding landscape are the focal points of the majority of the settlements within the Study Area, which results in clustering of historic and recreational features in their immediate surrounds. Cong is one such example, with Ashford Castle. the low-lying limestone plain to the east of the Lough Corrib with its large, walled fields, is used primarily for the more intensive rearing of sheep and cattle. Drumlins of glacial origin give rise to the numerous smaller, mostly wooded islands for which the lake is famous. The lake is highly prized as recreational fishery resource and is also the focus of many viewing areas and scenic drives. The whole of the lake and surrounds are classified as the highest sensitivity in the CDP, a classification which is appropriate given the qualities outlined above, therefore the rating of the Lakeland component of the Study Area is rated **High**, with areas of **Medium** in the more developed, pastoral areas.

4.9. Landscape Effects

The physical landscape as well as the character of the Site and the Central Study Area (<5km) is influenced by the proposed wind turbines and associated infrastructure. By contrast, for the Wider Study Area, landscape impacts relate exclusively to the influence of the proposed turbines on landscape character. The aspects of the Proposed Development that are likely to have an impact on the physical landscape and landscape character are described in Chapter 2 (Description of Proposed Development) with construction processes described in the Construction and Environmental Management Plan (CEMP) at Appendix 2.1. It should be noted in this instance, the magnitude of impact is derived from the difference between the Permitted Development and the Proposed Development.

4.9.1. Assessment of Effects During Construction

As the Proposed Development relates to alterations to the Permitted Development, the construction impacts will be very similar and potentially reduced with the revisions to connect to the existing Ardderroo substation rather than constructing the consented one. However, the new grid connection proposal will see an increase to the infrastructure at Ardderroo substation in the form of an IPP control building (c. 75m2), additional transformer & bund and associated electrical equipment and plinths. The revised underground cabling route will run within an existing forestry road that will need to be upgraded and widened. There is also a new cable service track running parallel to the existing road accessing the Ardderroo Substation. There may also be a marginal increase in excavation and land disturbance to facilitate the larger turbine foundations. These are very minor changes in the context of physical land disturbance in this already modified forestry and wind farm setting (see Plate 4.2 below). Overall, the magnitude of landscape impacts during construction are deemed Negligible and the quality of the effect will be Neutral.

4.9.2. Assessment of Effects During Decommissioning

Decommissioning stage effects will be similar in nature to construction stage effects, but in reverse (dismantling of turbines) and covering a shorter duration. It is considered that decommissioning stage effects will not be materially different to those that would have been required for the Permitted Development. Consequently, these are also considered to be Negligible in magnitude and Neutral in quality.

Figure 4.3 Context of existing Ardderroo Substation

4.9.3. Assessment of Effects During Operation

For most commercial wind energy developments, the greatest potential for landscape impacts to occur is as a result of the change in character of the immediate area due to the introduction of tall structures with moving components. Thus, wind turbines that may not have been a characteristic feature of the area become a new defining element of that landscape character. However, in this instance, wind turbines are already a strongly characteristic feature of the Central Study Area, most notably to the north and west of the site where the expansive Galway Wind Park and Ardderroo Wind Farm occupy the sparsely populated moorland / conifer forest covered hill country. Furthermore, the baseline of this assessment is the Permitted Development turbines with slightly lower tip heights and smaller rotor diameters.

There will be a fractional increase in the scale and intensity of the development due to the larger rotor diameters and slightly increased tip heights of the turbines. However, there remains the same number of commercial scale turbines within a landscape already defined by wind energy development and other extensive land uses such as forestry and upland farming. This is a landscape context that can readily accommodate the marginal increase in the size of the turbines without a sense of them being over-scaled or overbearing. Whilst the changes to the grid connection balance the omission of the permitted substation with a minor increase in the infrastructure required at the existing Ardderroo substation, these elements are strongly contained by undulating terrain and forestry in the heart of the Galway Wind Park and Ardderroo Wind Farm where they have little influence on the wider landscape character.

The underlying wind energy policy area has altered slightly between the current and previous Galway County Development Plan iterations, such that two of the turbines in the eastern portion of the development are now in an area indicated as 'Not Normally Permissible' for wind energy development, and two others straddle the border between the 'Strategic' area and the 'Not Normally Permissible' areas. The site had previously been fully contained within the 'Strategic' area for wind energy development that is generally occupied by Galway Wind Park and Ardderroo Wind Farm. The fact that the site could now straddle an abrupt border between the most and least accommodating wind energy policy areas in the county, but that border not be apparent in physical landscape terms, highlights why the altered zoning is not considered to be a material issue for the proposed development. Not only could the permitted development be constructed using the current turbine locations, they are all

contained within the same landscape character unit, right at the edge of a landscape that is now principally defined by wind energy development.

On balance of these reasons the magnitude of operational stage landscape impact is Low-negligible and marginally negative i.e., Neutral-Negative.

4.9.4. Significance of Potential Landscape Effects

Overall, the significance of construction stage landscape impacts is deemed to be **Imperceptible** and during the Operational stage will be no greater than **Slight-imperceptible** due to the marginally increased scale of the proposed turbines relative to their permitted counterparts.

4.10. Visual Effects

Visual impacts were assessed at all 20 of the original viewpoint locations used for the now permitted Knockranny Wind Farm and one additional viewpoint location, using photomontages that incorporate the Permitted Development as the baseline condition. This allows a direct comparison between the Permitted Development and the current proposal for slightly larger turbines. It is the uplift in visual impact as a result of the larger turbines that is the focus of the assessment. The individual visual assessment at each viewpoint is contained in Appendix 4.1 and summarized in Table 4.11 below.

Viewpoint No.	VP Sensitivity	Significance/ Quality / Duration of Impact
VP1	High	Imperceptible/ Neutral/ Long-term
VP2	High – Medium	Imperceptible/ Neutral/ Long-term
VP3	High – Medium	Imperceptible/ Neutral/ Long-term
VP4	Medium - Low	Imperceptible/ Neutral/ Long-term
VP5	High – Medium	Imperceptible/ Neutral/ Long-term
VP6	Medium - Low	Slight-imperceptible/ Negative-Neutral/ Long-term
VP7	High	Slight/ Neutral-Negative/ Long-term
VP8	Medium-Low	Slight-imperceptible/ Negative/ Long-term
VP9	Medium - Low	Slight-imperceptible/ Neutral-Negative/ Long-term
VP10	Medium - Low	Slight-imperceptible/ Neutral-Negative/ Long-term
VP11	Medium - Low	Slight-imperceptible/ Neutral-Negative/ Long-term
VP12	Medium - Low	Imperceptible/ Neutral/ Long-term
VP13	Medium - Low	Imperceptible/ Neutral/ Long-term
VP14	Medium - Low	Imperceptible/ Neutral/ Long-term
VP15	Medium - Low	Imperceptible/ Neutral/ Long-term
VP16	Medium	Imperceptible/ Neutral/ Long-term
VP17	Medium - Low	Imperceptible/ Neutral/ Long-term
VP18	Medium	Imperceptible/ Neutral/ Long-term
VP19	Medium	Imperceptible/ Neutral/ Long-term
VP20	High	Imperceptible/ Neutral/ Long-term
VP21	Medium-low	Slight-imperceptible/ Neutral-Negative/ Long-term

Table 4.11 Summary Visual Impact Assessment (derived from Appendix 4.1)

As can be seen from the summary results in Table 14.1 the impacts from the proposed increase in turbine height and rotor diameter only range between Slight and Imperceptible. This reflects the fact that the overall turbine height increase is a maximum of 19.5m for five of the permitted turbines and only 9.5m for the remaining six. In the context of 150m tall turbines, this is a relatively small proportional change albeit, the proposed turbines incorporate noticeably larger rotor diameters to achieve those height increases. It is also critical to note that the Ardderroo Wind Farm is currently under construction (nearing completion) immediately adjacent to the west of the Knockranny turbines. Indeed, the nearest turbines from the two developments are less than 750m apart. The Ardderroo turbines have a permitted rotor diameter of 150m and an overall tip height of 178.5m, which is taller than the proposed Knockranny turbines. The consolidated 150m tall, proposed turbines will form a more cohesive cumulative arrangement with the adjacent Ardderroo turbines than the lower variable heights (130.5m and 140.5m) of the permitted Knockranny development. The Proposed Development incorporates turbine heights that are also considered modest by current application standards where turbine tip heights of 180m+ have become the norm in recent years. The very minor difference in the turbine design between the permitted and proposed developments is accounted for in the photomontages and is therefore considered in the visual impact assessment. The design / aesthetic variation is not considered material to the visual impact.

At almost all viewpoints, except for the very distant VP20 from the island of Inis More, there is a discernible difference between the Permitted Development and Proposed Development turbines. This manifests as the proposed turbines appearing slightly larger and perceptually closer than their permitted counterparts. In some instances such as at the close VP9, it also results in the turbine cluster appearing slightly denser and more overlapped than the permitted array, as the larger rotor diameters encroach on each other's space to a slightly greater degree. However, such alteration in effects require a degree of scrutiny and the proposed development will still be read as eleven closely comparable scale turbines in the same locations as the permitted turbines. They are contained within the context of the same broad landscape setting that can readily accommodate the minor scale increase without generating issues of scale conflict and they are surrounded by a substantial number of turbines from the surrounding Galway Wind Park, which are read at different scales due to distance, topography or variance in dimensions. These factors tend to rationlise any increase in visual impact from the proposed larger Knockranny turbines.

The highest significance of visual impact is 'Slight' and this occurs at just one location (VP7 – Ross Demesne). The actual magnitude of change is no higher than at any of the other locations (Low-negligible), it is just that the High sensitivity of this receptor renders the significance marginally greater than the 'Slight-imperceptible' judgements attributed to five of the other locations (VP6, VP8, VP9, VP10, VP11 and VP21). These are all viewpoints within the Central Study Area, where the variation in scale between the permitted and proposed turbines is more discernible. At the remaining 14 VP locations, the scale variation may be discernible, but it is not considered to have any material bearing on visual amenity. Thus, the significance of visual impacts at these locations is deemed to be 'Imperceptible'.

Note that the location of VP21 was altered slightly subsequent to pre-planning public consultation where several residents highlighted that more open visibility of the Proposed Development was available nearby.

4.11. Mitigation Measures and Monitoring

4.11.1. Construction Phase

There are no specific landscape and visual related mitigation measure considered necessary during the construction stage.

4.11.2. Operational Phase

There are no specific landscape and visual related mitigation measure considered necessary during the operational stage.

4.12. Residual Effects

As there are no specific landscape and visual related mitigation measures proposed during the construction or operational phases, residual effects will be the same as already assessed in sections 4.9 and 4.10.

4.13. Cumulative Effects

4.13.1. Construction Phase

There is not considered to be any material construction stage cumulative effects of an adverse quality because the adjacent Ardderroo Wind Farm and its associated substation will be fully completed before construction of the Knockranny development commences. The fact that the proposed development will now tie in to the existing Ardderroo substation rather than constructing a separate substation facility is likely to result in a beneficial cumulative impact relative to the permitted development.

4.13.2. Operational Phase

The proposed increase in the scale of the Permitted Development turbines will not result in impacts that are generally greater than Slight-imperceptible and none of these increase in impacts relate to the relationship of the proposed turbines with other surrounding wind farms. Consequently, it is not considered that there will be any material increase in cumulative impacts resulting from the Proposed Development.

4.14. Difficulties Encountered in Compiling Information

It was difficult during winter months to find a weather window that would guarantee clear viewing conditions from the island of Inis More in order to recapture up-to-date photography for VP20 from the original application. Furthermore, this receptor is well beyond a distance that would be required to assess even a new wind energy development on this site. Given that the proposed development also relates to a modest increase in the scale of the permitted turbines within the wider Galway Wind Park, it was not considered necessary to recapture photography for the relatively unchanged VP20. Previous photography was used instead.

4.15. References

- Environmental Protection Agency (EPA) publication 'Guidelines on the Information to be contained in Environmental Impact Statements (2022) and the accompanying Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (2017).
- Department of Environment Heritage and Local Government (DoEHLG) Wind Energy Planning Guidelines (2006/2019 revision) and Preferred Draft Approach to revising the 2006 Guidance published 2017.
- Landscape Institute and the Institute of Environmental Management and Assessment publication entitled Guidelines for Landscape and Visual Impact Assessment (2013).
- Nature Scot Guidance Note: 'Assessing the cumulative impact of onshore wind energy developments' (2021).
- Scottish Natural Heritage (SNH) Siting and Designing Wind Farms in the Landscape Version 3 (2017).

CNOC RAITHNÍ (KNOCKRANNY) WIND FARM

CHAPTER 5

Material Assets – Traffic and Transport

VOLUME II EIAR

CHAPTER 5 - Traffic & Transport

Contents

Chapter 5

5. MATERIAL ASSETS – TRAFFIC & TRANSPORTATION

5.1. Introduction

The objective of this chapter is to consider the traffic implication of the Proposed Development, part of the Cnoc Raithní (Knockranny) Wind Farm Project. This Traffic and Transport Assessment ("TTA") quantifies and assesses the proposed access route and the impact of the traffic generated by the Proposed Development on the existing local road network. This includes the likely impact of the construction and operational generated traffic on the surrounding road network. Mitigation measures are recommended as appropriate. A detailed description of the development is provided in Chapter 2 of this EIAR.

5.1.1. Objectives

This report provides an assessment of the potential traffic and transport impacts in the construction, operational and decommissioning phases associated with the Proposed Development in accordance with the "Traffic and Transport Assessment Guidelines (2014)" as published by the TII. In this regard, the assessment aims to:

- Identify the existing environment in terms of traffic and transportation;
- Quantify the likely vehicle traffic flows to and from the development onto the surrounding road network;
- Identify and quantify the likely traffic impacts on the surrounding road network resulting from the development; and
- Identify suitable measures to mitigate traffic and transportation impacts, if any, associated directly with the development.

This Chapter examines all construction related traffic, including material and turbine deliveries, and staff traffic as well the impacts of the underground cabling and grid connection route (between the Proposed Development and Arderroo Substation) on existing carriageways, with a view to assessing any additional effects, over and above those identified for the permitted development as identified in the previous EIS, arising from the Proposed Development. The operational phase examines the associated traffic impact which mainly comprises turbine maintenance. The decommissioning phase examines the associated traffic impact which will be similar to that of the Permitted Development.

The potential cumulative impacts from the other projects as shown in Chapter 1 and Chapter 2 were considered.

5.2. Assessment Methodology

The methodology adopted for this report is summarised as follows:

- Define forecasting methods;
- Appraisal of existing road network;
- Appraisal of existing traffic flows;
- Establish future background flows;
- Establish development trip generation;
- Identify proposed development site access arrangements;
- Appraisal of predicted traffic flows;
- Appraisal of the predicted traffic impacts on the local links;
- Identify proposed mitigation measures; and
- Appraisal of mitigation measures.

5.3. Baseline Conditions

5.3.1. Existing Road Network and Site Access

The following sections summarise the local road network adjoining the proposed Site.

N59 National Secondary Road

The N59 National Secondary Road runs northwest to southeast approximately 2.5 kilometres east of the Site. The N59 is a rural interurban route that links Galway City to the southeast with Clifden to the northwest, via Oughterard.

The L-53453 intersects the N59 at Doon, forming a priority-controlled junction approximately 3 kilometres northeast of the Site, approximately 4 kilometres north of Moycullen and 1 kilometre south of Rosscahill. The N59, in the vicinity of the junction, is a bi-directional two-lane single carriageway with a typical total width of approximately 7.0 metres, with 0.5 metre hard strips but without any pedestrian footpath and cycle facilities. The horizontal alignment of the N59 is reasonably straight and the vertical alignment of the N59 is reasonably level, adjacent to the N59 / L-53453 junction. The N59 / L-53453 junction is within the 100 kph speed limit zone.

L-53453

The L-53453 is an approximately 675 metres long local road which serves some residential dwellings, a small number of farm premises, turbary areas and Coillte forestry land. The L-53453 is a single carriageway road with a minimum carriageway width of approximately 5 metres but without any pedestrian footpath and cycle facilities. The vertical alignment of the first circa 30 metres of the L-53453 is on a relatively steep incline. The L-53453 also includes a series of horizontal bends.

N59 / L-53453 Access Junction

The N59 / L-53453 junction was upgraded, including road widening to the eastern side of the N59, to accommodate the swept path for abnormal loads. These modification works can facilitate the delivery of abnormal loads by large articulated HGVs to the Site via N59 and L-53453. Figure 5-1 and Figure 5-2 following illustrate the existing N59 / L-53453 junction.

Figure 5.1 Improved N59 / L-53453 Junction – looking south along the N59 with layby / turning area on left
(Source: Google Maps)

Figure 5.2 Improved N59 / L-53453 Junction – looking west along the L-53453
(Source: Google Maps)

Existing Roads (no name)

A network of minor agricultural, turbary and forestry access roads (approximately 4 kilometres) connect the L-53453 with the Site. The roads are utilised by forestry operations, existing wind farms and local residents (including hauling turf and associated equipment).

5.4. Assessment

This section estimates the trip generation and examines the potential impact of the Proposed Development on the local road network. The local road network has been assessed under the "Do-Nothing" scenario whereby the Permitted Development would be constructed and "Assessment of Effects During Construction" scenario for the Proposed Development.

5.4.1. Base Year 2023 – Traffic Volumes & Capacity

Generally, to determine current traffic behaviour in the vicinity of the subject Site, historic traffic data (i.e. 2013 year) from the Permitted Development EIS was obtained and interrogated. To estimate the 2023 baseline year traffic flows, the historical 2013 year traffic flows were factored up to 2023 year by utilizing the growth factors measured from the nearest TII Automatic Traffic Counter (ATC) on the N59 between Oughterard and Moycullen (TMU N59 280.0 S), which is located 1 kilometre southeast of the N59 / L-53453 junction, and TII Project Appraisal Guidelines for National Roads 'Unit 5.3 - Travel Demand Projections'. The calculations are detailed in Appendix 5.1. However, based on this methodology, the calculated 2023 AADT flows on the N59 (i.e. 5,399) is less than the 2022 AADT flows on the N59 (i.e. 7,852) recorded in the above-mentioned ATC station. To provide a robust analysis, the 2022 AADT flows on the N59 recorded in the above-mentioned ATC station were adopted for the assessment. Thus, the 2023 AADT flows on the N59 were calculated by factoring up the 2022 AADT flows recorded in the above-mentioned ATC station in accordance with the Table 6.2 of TII Project Appraisal Guidelines for National Roads 'Unit 5.3 - Travel Demand Projections'. Medium growth rate factors have been utilised. Table 5.1 below presents the 2023 baseline year two-way AADT and HGV flows.

Table 5.1 : 2023 Baseline Year AADT and HGV Flows based on the TII Automatic Traffic Counter (ATC) on the N59

Link	Two-Way AADT Flows Vehicles	
	Total	HGV
N59 National Secondary Road - Southeast	8,062	353
N59 National Secondary Road - Northwest	8,062	353
L-53453*	331	12

Note: * The calculation of AADT flows for L-53453 is presented in Appendix 5.1.

5.4.2. Assessment Year

Assuming planning permission is granted for the proposed development in 2023 and allowing for a 16-18 month construction period, it is estimated that the development will be fully operational by 2025. Traffic analysis associated with the impact of the construction works will, therefore, focus on the Final Year of Construction (i.e. 2025). It should be noted that while the assumed construction years of 2024 / 2025 may vary slightly, this will not alter the forecast outcomes and effects presented in this section of the EIAR. This is due to the annual growth rate for background traffic being just 1.0109 for passenger car traffic and 1.0198 for HGV (as shown in Table 6.2 of TII Project Appraisal Guidelines for National Roads 'Unit 5.3 - Travel Demand Projections'), and the traffic volumes generated by the Proposed Development will remain unchanged regardless of construction year, as detailed later in Section 5.4.8.

5.4.3. Proposed Haulage Route

The proposed haulage route to the Cnoc Raithní (Knockranny) Wind Farm development remains unchanged from that of the Permitted Development. The Project haulage route would follow the N59 as far as Doon, where the L-53453 intersects the N59. From Doon, the proposed haulage route would follow the L-53453. Access to the Site from this roadway is via the Ardderroo Co-Operative and Forestry cul-de-sac road and then via the construction of a new section of ground bearing roadway through an area of cutaway bog. The Project haulage route would provide the only access to the Site and would be used for construction, turbine delivery, material delivery, staff and visitor trips. The location of the Site and the proposed haulage route (in Pink) are shown in Figure 5-3 below.

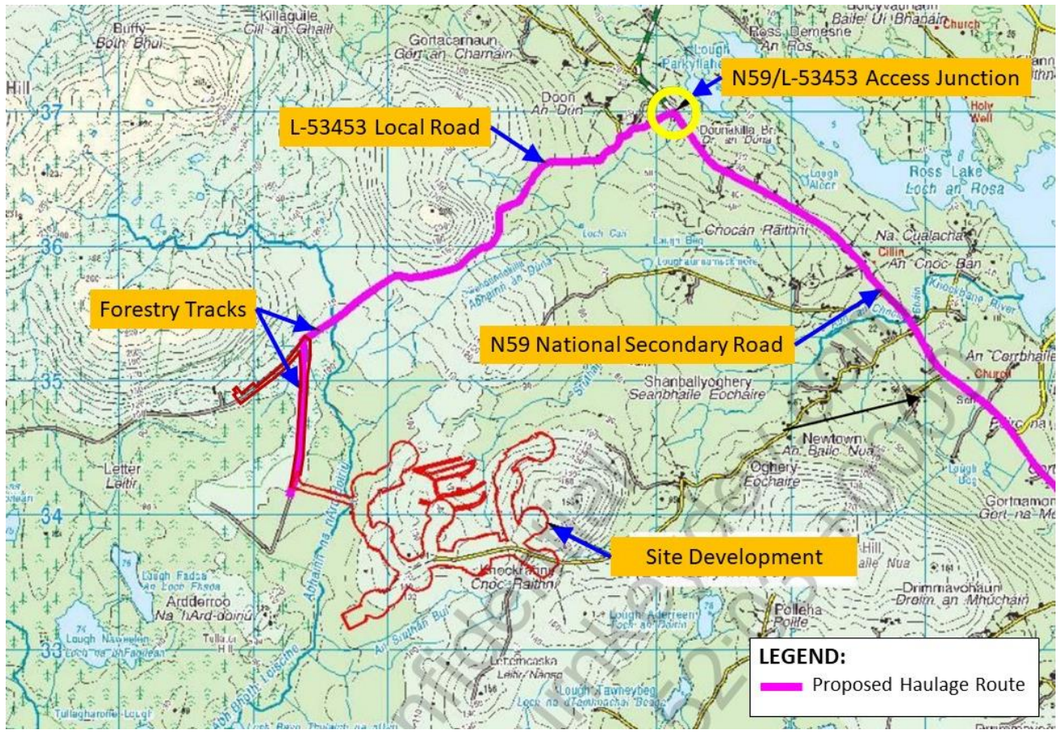

Figure 5.3 Location of the Site and Proposed Haulage Route
(indicative subject Site outline in red)

5.4.4. Road Link Capacity Assessment

A flow capacity assessment was undertaken on the proposed haulage route road network. TII DN-GEO-03031 - Rural Road Link Design (2017) was used to establish the estimated capacity of the N59 and L-53453. "Table 6.1: Recommended Rural Road Layouts" of this document provides estimated capacities for a number of different rural road types, as an approximation of Level of Service D. Level of Service D is the level of service at which passing becomes extremely difficult, with shock waves beginning to affect the overall traffic flow. This is commonly taken to be the level of traffic representing the practical capacity of a road link.

The N59 is classified as "*Type 2 Single (7.0 metres) carriageway",* which has an estimated capacity of 8,600 AADT. As the L-53453 has a typical carriageway width of 5.0 metres, it cannot be classified to any road type based on *Table 6.1 of TII DN-GEO-03031 - Rural Road Link Design (2017)*. Therefore, the estimated capacity for L-53453 has been estimated as a proportion of the capacity of a Type 2 Single (7.0 metres) carriageway (i.e. 8,600 AADT). The NRA's publication RT. 180 Geometric Design Guidelines (1986) was used to establish the flow capacity of the L-53453. Table C4.2 (b) Design Capacities for Undivided Rural Roads of this document provides two-way link capacities for Level of Service D represented in passenger car units (pcu)[1]. In this Table, the following capacities are provided:

- 7.0 metres width – 1,500 pcu/hour; and
- 5.0 metres width – 1,175 pcu/hour.

The capacity for a 5.0 metres wide road is the lowest capacity provided in the NRA's publication RT. 180 Geometric Design Guidelines (1986). The ratio between the 7.0 metres carriageway and the 5.0 metres carriageway road width was calculated as 0.783. This ratio was applied to the 7.0 metres carriageway estimated capacity (i.e. 8,600 AADT) to establish the estimated capacity of the L-53453 with a carriageway width of 5.0 metres, which gives an estimated capacity of 6,734 AADT.

5.4.5. Capacity Assessment for 2023 Baseline Year

The following Table 5.2 presents the estimated link road capacities and estimated flows for the N59 and the L-53453 in the 2023 baseline year.

Table 5.2 : 2023 Baseline Year – Link Capacity Analysis

Link	Estimated Capacity (AADT)	Highest Demand (AADT)	Used Capacity (%)
N59 National Secondary Road - Southeast	8,600	8,062	93.7%
N59 National Secondary Road - Northwest	8,600	8,062	93.7%
L-53453	6,734	331	4.9%

The normal design threshold for the ratio of flow to capacity (RFC) is 1.0 (100%) for a road link. The results shown in Table 5.2 demonstrate that the N59 and L-53453 are operating within the normal design threshold in the 2023 Baseline Year scenario.

5.4.6. 2025 Design Year Traffic Flows

2025 Background Traffic Flows

The projected 2025 background traffic flows have been calculated by factoring up the 2023 baseline year AADT flows (as shown in Table 5.1) in accordance with the TII Project Appraisal Guidelines for National Roads - Unit 5.3 Travel Demand Projections, Table 6.2: Link-Based Growth Rates: County Annual Growth Rates (excluding Metropolitan Area). The following Table 5.3 presents the 2025 design year background AADT and HGV flows.

[1] PCU means Passenger Car Unit. A passenger car equivalent is essentially the impact that a mode of transport has on traffic variables (such as headway, speed, density) compared to a single car. For example, 1 private car is equal to 1 pcu and 1 Public Service Vehicle is equal to 2 pcu.

Table 5.3 : 2025 Background AADT and HGV Flows

Link	Two-Way AADT Flows Vehicles	
	Total	HGV
N59 National Secondary Road - Southeast	8,498	385
N59 National Secondary Road - Northwest	8,498	385
L-53453	366	24

Trip Generation by the other Wind Energy Projects

With regard to Galway Wind Park, 60 of the 69 permitted turbines have been constructed to-date, with 9 remaining turbines to be constructed. In the case of the Ardderroo Wind Farm development, 22 of the 25 permitted turbines have been constructed with construction on-going for the remining 3 turbines. Overall, there are 12 remaining permitted turbines to be constructed. The EIAR submitted for the Ardderroo Wind Farm development noted that peak construction activity would be concrete pouring for wind turbine foundations, which would generate a maximum flow of 432 two-way vehicles (of which 367 would be HGVs and 65 LGVs) per day. As the Ardderroo Wind Farm has some of the taller turbines in Ireland, this trip generation figure has been adopted to provide a robust analysis of the potential additional trips that the construction of these remaining unconstructed turbines could generate on the road network. However, it was assumed that construction programming will ensure that the concrete pouring for the remaining turbine foundations at these adjacent wind farms would not take place concurrently with that of the Proposed Development in order to minimize the traffic impacts to public.

2025 Design Year Traffic Flows

The 2025 design year traffic flows comprise the 2025 background traffic flows as shown in Table 5.3 plus the potential trip generation by the other Wind Energy Projects (i.e. 432 two-way vehicles (367 HGVs) per day). Table 5-4 below presents the two-way AADT and HGV flows.

Table 5-4: 2025 Design Year AADT and HGV Flows

Link	Two-Way AADT Flows Vehicles	
	Total	HGV
N59 National Secondary Road - Southeast	8,995	817
N59 National Secondary Road - Northwest	8,498	385
L-53453	863	456

5.5. Likely Significant Impacts

5.5.1. "Do-Nothing" Scenario

If the Proposed Development were not to proceed, the already permitted 11-turbine layout would be constructed under the terms of the Galway County Council Planning Ref. No. 13/829 and An Bord Pleanála Ref: 07.243094 planning permission. The opportunity to increase the energy output from County Galway's valuable renewable energy resource would be lost, as would the opportunity to further contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. If the Proposed Development does not proceed, no additional effects with respect to traffic beyond those previously identified in the EIS for the Permitted Development are foreseen.

5.5.2. Assessment of Effects During Construction

The 2025 "Assessment of Effects During Construction" scenario traffic flows for the Proposed Development comprises the 2025 background traffic flows as shown in Table 5.5 plus the potential trip generation by the other Wind Energy Projects (i.e. 432 two-way vehicles (367 HGVs) per day) and the trip generation by the Cnoc Raithní (Knockranny) Wind Farm development under the Proposed Development. The trip generation by the Cnoc Raithní (Knockranny) Wind Farm development under the Proposed Development and associated traffic impact is discussed in the following sections.

Assessment of Peak Construction Trip Generation for Different Element of Works

Due to the nature of works, the different construction elements, including earthworks, road works, concreting to turbine foundations, backfilling, mechanical installations, electrical installation, etc., will be constructed sequentially. Based on the information provided by the design team, the activities for "concreting turbine foundation" and "importing fill material" will be the two highest trip generation / attraction activities during construction and they will not be undertaken concurrently.

As a result of the proposed increase of the size of 11 wind turbines for the Cnoc Raithní (Knockranny) Wind Farm development, it has been estimated that the concrete required for each turbine foundation would increase from 500 m^3 to 675 m^3, with an additional c. 50m^3 for blinding and an additional 1,350 m^3 of imported fill material would be required for the 11 wind turbine foundations. It is noted that the blinding takes places prior to the main concreting of the turbine foundations, resulting in separate and not concurrent trip generation.

Table 5.5 : Additional Trip Generation During Construction under "Assessment of Effects During Construction" Scenario for the Proposed Development

Element	Additional Volume (m^3)	Loading per Truck* (m^3)	Period	Additional HGV (Veh/day)		Additional HGV Movements (Veh/day)
				Arrivals	Departures	
Concreting 11 turbine foundations	1,925	8	11 days	22	22	44
Blinding	550	8	11 days	7	7	14
Importing fill material for 11 turbine foundations	1,350	9	14 days	11	11	22

Note: * *It is assumed that loading per concrete truck and dump truck are 8 m3 and 9 m3 respectively.*
** *It is assumed that working period for importing fill material is 14 days.*

The Permitted Development EIS, also identified that the peak construction traffic trips under the Permitted Development would occur during concrete pouring for turbine foundations. Table 5.5 summarises the additional construction traffic trips associated with the Proposed Development for these additional concrete and fill requirements.

Trip Generation by Concrete deliveries for Turbine Foundations under the Proposed Development

As outlined in Table 5-5, the additional 1,925m^3 of turbine foundation concrete required under the Proposed Development, assuming a loading per concrete truck of 8 m^3, is estimated to generate a maximum of 44

movements (22 inbound and 22 outbound) additional daily HGV trips during the peak construction period under the Proposed Development. As noted above the importation of fill material, which would require 22 daily HGV movements would not be undertake concurrently, therefore the peak daily construction HGV movements is 44 based on the turbine concrete requirements.

Trip Generation by Staff under the Proposed Development

There will be no additional construction staff required on site as a result of the Proposed Development *therefore no additional staff trips would arise*.

Trip Generation by other Construction Activities under the Proposed Development

As a result of the proposed amendment of underground cabling and grid connection works to the Ardderroo Substation, the length of underground cabling and grid connection would increase. However, the trip generation due to the underground cabling and grid connection works to the Ardderroo Substation is less than the peak construction trip generation for concreting the turbine foundation. Additionally, the construction of the underground cabling route will be programmed to ensure that it does not coincide with the peak period related to the concrete pouring for turbine foundations. To provide a worst-case scenario, the peak construction trip generation for concreting the turbine foundation has been adopted instead of trip generation from the underground cabling and grid connection works to the Ardderroo Substation.

The underground cabling and grid connection works undertaken as part of the Proposed Development will include the upgrading of the existing forestry road to tie in with the existing Ardderroo Wind Farm access road, the trenching through the existing Ardderroo Wind Farm access road, an off-road service track to the south of the Ardderroo substation and the substation extension. However, the trip generation due to the above-mentioned works will be scheduled across a longer period and be less than the peak construction trip generation for concreting the turbine foundation. Additionally, the above-mentioned construction works will be programmed to ensure that it does not coincide with the peak period related to the concrete pouring for turbine foundations. To provide a worst-case scenario for analysis, the peak construction trip generation for concreting the turbine foundation has been adopted instead of trip generation from the above-mentioned works.

Moreover, there will be no additional vehicles required for daily regular construction activities (i.e. delivery of materials and diesel) as a result of the Proposed Development.

Trip Distribution and Traffic Flows under 2025 "Assessment of Effects During Construction" Scenario for the Proposed Development

As outlined in Table 5.5, the uplift in Peak Construction Trip Generation arising from the Proposed Development is 44 no HGV movements per day. As noted in Table 5-6, this in combination with the Permitted Development Peak Construction Trip Generation of 146 no HGV movements and 50 construction staff movement would generate an overall Project maximum of 240 movements (190 HGVs) per day during the peak construction period (i.e. 11 days).

The 2025 "Assessment of Effects During Construction" scenario for the Proposed Development equates to the sum of traffic flows under 2025 design year traffic flows as shown in Table 5.6 and trip generation by the overall Project – the Cnoc Raithní (Knockranny) Wind Farm development (i.e. 240 two-way vehicles (190 HGVs) per day). During the peak construction period, materials would be sourced locally and transported via the N59 and L-53453. By adopting the predicted trip distribution on the N59 under the Permitted Development EIS, a ratio of 60%:40% to the southeast and northwest respectively has also been applied for assessment.

The following Table 5-6 presents the two-way AADT and HGV flows under 2025 "Assessment of Effects During Construction" scenario for the Proposed Development.

Table 5-6: 2025 Design Year AADT and HGV Flows under "Assessment of Effects During Construction" Scenario for the Permitted and the Proposed Development

Link	Two-Way AADT Flows Vehicles (HGV)									
	Concreting the Turbine Foundation		Staff		Other Construction Activities (i.e. Deliveries)		2025 Design Year Traffic Flow		2025 "Assessment of Effects During Construction" Scenario for the Proposed Development	
	Total	HGV	Total	HGV	Total	HGV	Total	HGV	Total	HGV
N59 National Secondary Road - Southeast	102	102	30	0	12	12	8,995	817	9,139	931
N59 National Secondary Road - Northwest	68	68	20	0	8	8	8,498	385	8,594	461
L-53453	170	170	50	0	20	20	863	456	1,103	646

Construction Phase Traffic Impact under 2025 "Assessment of Effects During Construction" Scenario for the Proposed Development

The following Table 5.7 presents the estimated link road capacities and two-way link flows for the N59 and the L-53453 under 2025 "Assessment of Effects During Construction" scenario for the Proposed Development.

Table 5-7: 2025 "Assessment of Effects During Construction" Scenario for the Proposed Development – Link Capacity Analysis

Link	Estimated Capacity (AADT)	Highest Demand (AADT)	Used Capacity (%)
N59 National Secondary Road - Southeast	8,600	9,139	106.3%
N59 National Secondary Road - Northwest	8,600	8,594	99.9%
L-53453 Local Road	6,734	1,103	16.4%

The normal design threshold for the ratio of flow to capacity (RFC) is 1.00 (100 %) for a road link. The results shown in Table 5.7 demonstrate that the N59 – Northwest and L-53453 will operate within the normal design threshold for Level of Service D under 2025 "Assessment of Effects During Construction" scenario for the Proposed Development. However, the N59 – Southeast will operate slightly over the normal design threshold under 2025 "Assessment of Effects During Construction" scenario for the Proposed Development.

To provide a worst-case scenario, the peak construction activity (i.e. concreting the turbine foundation) was adopted in order to provide a robust analysis because the trip generation for concreting the turbine foundation is the highest and other construction works will be programmed to ensure that it does not coincide with the peak period related to the concrete pouring for turbine foundations. The proposed increase of the size of 11 wind turbines for the Proposed Development will generate an additional 44 two-way daily HGV trips during the peak construction period. This level of additional traffic to that of the Permitted Development will have only a minimal impact on the surrounding roads. As a conservative approach was adopted in this assessment and the maximum

additional peak HGV traffic flows generated by the Cnoc Raithní (Knockranny) Wind Farm development under the Proposed Development would occur over an 11 day period, the traffic impacts on the surrounding roads during the construction phase would be considered as "Not Significant" and "Temporary Effects" as a result of the Proposed Development.

Delivery of the Large Wind Farm Plant / Equipment

The point of arrival for the large wind farm plant will be Galway Harbour with the convoys following the same delivery route as was used for construction and abnormal load deliveries to the neighboring Galway Wind Park Site and Ardderroo Wind Farm development. The construction traffic for the 11 turbines will turn left off the N59 on to the existing L-53453, approximately 18 kilometres northwest of Galway City as indicated on Figure 5-3.

The delivery route has been proven to be technically feasible in relation to the delivery of adjoining turbines with blade lengths of c. 75 metres and an overall tip height of c.178 metres, both in excess of the specification of the turbines in the Proposed Development.

Appendix 5.2 and Appendix 5.3 of this EIAR present the route and autotrack assessments through Galway City and L-53453 (including the existing N59 / L-53453 junction) respectively which demonstrate the feasibility of this route.

5.5.3. Assessment of Effects During Operation

There will be no additional trips generated during the operation of the project as a result of the Proposed Development.

5.5.4. Assessment of Effects at Decommissioning Phase

There will be no additional trips generated in the decommissioning of the projects as a result of the Proposed Development.

5.6. Mitigation Measures and Monitoring

It is recommended that the measures outlined in the following sections should be implemented to mitigate the traffic impacts associated with the development during the construction, operational and decommissioning phases of the Proposed Development.

5.6.1. Construction Phase

The following measures are recommended to ensure a safe and regulated traffic management system is enforced.

- Ensure a strict protocol for HGV drivers to follow the designated haulage route and timing restrictions regarding commuting traffic, as detailed;
- Advance warning should be given to the local residents and other road users (i.e., cyclists) for specific times when large volumes of HGV traffic may occur;
- All signage relating to the proposed construction traffic routes for construction traffic to be agreed with Galway County Council;
- A maximum speed limit would be imposed for HGVs on the local road network during the construction phase;
- A maximum speed limit of 20 km/hr would be imposed on the L-53453 and the internal site track roads;
- A well planned and executed delivery programme avoiding peak traffic on weekdays would be ensured (i.e., local school start and finish times);
- Adequate parking would be provided on Site for both employees and visitors to ensure parking would not occur on the public road;
- A road sweeping vehicle would be provided as required to remove any mud that is deposited on the N59 and L-53454;
- The condition of the N59 and L-53454 would be monitored on an on-going basis;
- Enforcement of existing regulatory markings and signages would be ensured; and
- Car pooling arrangements for regular employees.

Road Repairs

Pre-construction and post-construction surveys would be carried out to ensure the structural integrity of the proposed haulage route road network. If necessary, road repairs would be carried out on the public roads during the construction phase to ensure that the road condition does not deteriorate below a standard that could affect the use of the Site and public roads. Following completion of construction, the condition of the public road would be of at least the same standard as it was prior to commencement of construction.

Traffic Management Plan

Prior to commencement a Traffic Management Plan would be prepared following consultation with the Roads Department of Galway County Council. Construction activities associated with the Proposed Development would adopt working practices to ensure the safety and convenience of all road users (i.e. pedestrians, cyclists, drivers, etc.), during the construction of the development, as detailed previously.

To further minimize the traffic impacts to public, a Traffic Management Plan would be prepared in consultation and agreement with the relevant project developers to minimize peak construction traffic flows, in particular HGV traffic associated with concrete pouring for turbine foundations.

5.6.2. Operational Phase

It is envisaged that the Proposed Development would not generate any additional adverse impacts on traffic in the vicinity of the Site on a long-term basis, once the Site is in operation. Therefore, no additional mitigation measures would be required for the operational phase under the Proposed Development.

5.6.3. Decommissioning Phase

All infrastructure including turbine components will be separated and removed off-site for re-use, recycling and waste disposal. A Decommissioning Plan has been prepared as shown in Appendix 2.1.

5.7. Residual Effects

5.7.1. Construction Phase

During the construction phase of the Proposed Development, it is anticipated that the additional traffic that will appear on the public road network serving the site will have an imperceptible to not significant and temporary impact on existing road users, which will be minimized with the implementation of the mitigation measures outlined above.

For the 11 days for concrete pouring of turbine foundations, the Proposed Development will result in increased traffic volumes and the impacts will be considered as "Not Significant".

5.7.2. Operational Phase

As there will be no additional traffic related impacts arising from the Proposed Development during the operational phase, there will be no residual impacts during this phase.

5.7.3. Decommissioning Phase

As stated above, a Decommissioning Plan has been prepared and will be implemented in order to minimise the residual impacts during this phase.

As there will be no additional traffic related impacts arising from the Proposed Development during the decommissioning phase there will be no residual impacts during this phase.

5.8. Cumulative Effects

5.8.1. Construction Phase

Cumulative impacts are the potential combined impacts from other developments in conjunction with the proposal. The main potential for cumulative impacts for the Proposed Development is with the adjacent Ardderroo Wind Farm development as shown in Figure 5.4 below and the Permitted Galway Wind Park project. To-date, Ardderroo Wind Farm development has constructed 22 of the permitted 25 turbines while Galway Wind Park Project has constructed 60 of the permitted 69 turbines. Overall, there are 12 turbines yet to be constructed. While it is assumed that the Ardderroo Wind Farm will be completed prior to commencement of the Project, it is included here for completeness. The following points are noted with respect to the potential for cumulative impacts during construction phase:

Other Wind Energy Projects (i.e. Ardderroo Wind Farm development and Galway Wind Park Project)

- It was assumed that the concrete pouring for the remaining turbine foundations under Ardderroo Wind Farm development would not coincide with the concrete pouring for the remaining turbine foundations under Galway Wind Park project in order to minimize the traffic impacts to public. Therefore, 12 days would be required for completion of the concrete pouring for the Ardderroo Wind Farm development and Galway Wind Park.
- To provide a robust analysis, it was assumed that Proposed Development and Ardderroo Wind Farm development / Galway Wind Park project will be constructed concurrently and will use the same delivery routes to and from the site. However, construction programming for the Proposed Development will ensure that peak trip-generating construction activities will not coincide with peak trip generation activities on nearby sites.
- On the busiest delivery days for the above-mentioned developments, that is the 12 days that the concrete for the turbine foundations are being poured, there will be an additional 432 two-way vehicles (of which 367 HGVs and 65 LGVs) per day. It is considered that the cumulative impact resulting from these additional trips will be negative, slight and temporary lasting 12 days.
- To minimize the cumulative traffic impacts to the public, a Traffic Management Plan would be prepared in consultation and agreement with the relevant project developers to minimize peak construction traffic flows, in particular HGV traffic associated with concrete pouring for turbine foundations.

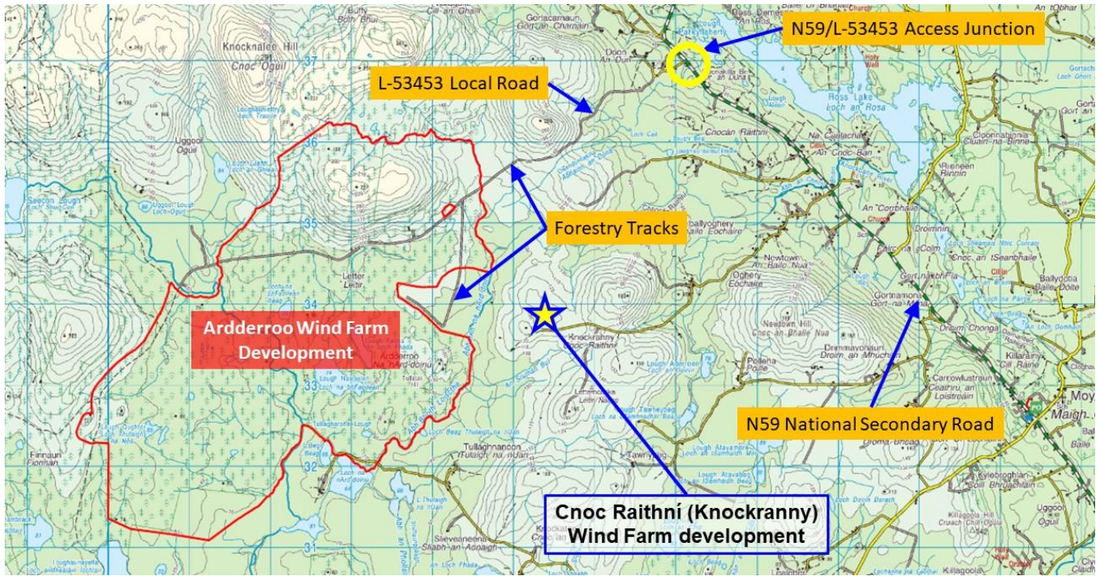

Figure 5.4 Location of the Ardderroo Wind Farm Development
(indicative subject Site outline in red)

Other Significant Construction Development

Chapter 1 of this EIAR also highlights two nearby transport projects, including "The proposed N59 Maigh Cuilinn (Moycullen) Bypass Road Project" and "The Connemara Greenway". The location of the above-mentioned two transport projects is shown in the Figure 5.5 below. The proposed N59 Maigh Cuilinn (Moycullen) Bypass Road Project is currently under construction and it is located to the southeast of the N59/L-53453 access junction and approximately 4.5 kilometres from the N59/L-53453 access junction. Therefore, the cumulative impact to the Proposed Development is considered to be minimal. The Connemara Greenway Project is currently at early planning stage so it is anticipated that the construction phase of the Connemara Greenway Project will not coincide with the peak construction activity of the Proposed Development.

To further minimize the traffic impacts to public, a Traffic Management Plan would be prepared in consultation and agreement with the relevant project developers to minimize peak construction traffic flows, in particular HGV traffic associated with concrete pouring for turbine foundations.

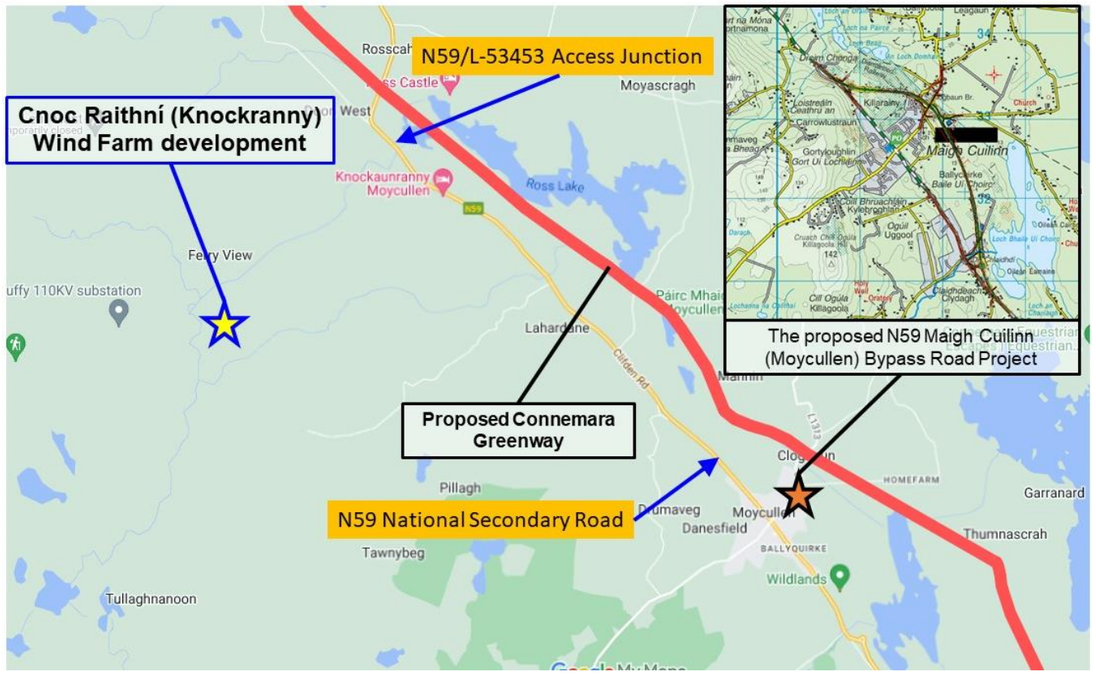

Figure 5.5 Location of two nearby Transport Projects

5.8.2. Operational Phase

As there will be no additional traffic related impacts of the Proposed Development during the operational phase, there will be no significant cumulative impacts during this phase.

5.8.3. Decommissioning Phase

As there will be no additional traffic related impacts arising from the Proposed Development during the decommissioning phase, there will be no significant cumulative impacts during this phase.

5.9. Difficulties Encountered in Compiling Information

There were no difficulties encountered in compiling this information.

5.10. References

- Traffic and Transport Assessment Guidelines (2014) as published by the former National Roads Authority (NRA) now TII;
- Design Manual for Urban Roads and Streets (DMURS) (2013 and updated in 2022) as published by the Department of Transport;
- TII PE-PAG-02017 - Project Appraisal Guidelines for National Roads 'Unit 5.3 - Travel Demand Projections' (2021) as published by the former NRA now TII;
- TII PE-PAG-02039 - Project Appraisal Guidelines for National Roads 'Unit 16.1 – Expansion Factors for Short Period Traffic Counts' (2016) as published by the TII;
- TII DN-GEO-03031 – Rural Road Link Design (2017) as published by TII; and
- Galway County Development Plan (2022 – 2028) as published by the Galway County Council.

CNOC RAITHNÍ (KNOCKRANNY) WIND FARM

CHAPTER 6

Material Assets – Service, Infrastructure and Utilities

CHAPTER 6 – Material Assets

Contents

Chapter 6

6. MATERIAL ASSETS – SERVICES, INFRASTRUCTURE AND UTILITIES

6.1. Introduction

This chapter describes the Material Assets – Services, Infrastructure and Utilities that may potentially be impacted by the Proposed Development which includes changes to the dimensions of 11 no. previously permitted Cnoc Raithni (Knockranny) Wind Farm wind turbines and a revised grid connection including underground cabling to the Ardderroo substation. A full description of the Proposed Development, development lands and all associated project elements is provided in Chapter 2 – Project Description of this EIAR.

The purpose of this assessment is to identify relevant Material Assets – Services, Infrastructure and Utilities that are within the vicinity of the Proposed Development site or will be utilised by the Proposed Development; determine the impact, if any, on these resources; and propose mitigation where necessary to ensure that, they are used in a sustainable manner, and to ensure that any potential significant impacts are avoided. Traffic & Transportation Material Assets are assessed separately in Chapter 5 of this EIAR.

6.2. Assessment Methodology

The following publications were consulted as part of the preparation of this assessment.

- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment, (Department of Housing, Local Government and Heritage, August 2018);
- Environmental Impact Assessment of Projects: Guidance on the Preparation of the Environmental Impact Assessment Report (European Commission 2022);
- Guidelines on the Information to be contained in Environmental Impact Assessment Reports (EPA, August 2022);
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (August 2018).

Table 6.1 outlines the topic areas to be examined when considering the impact of a development on Material Assets, as recommended in the 2022 EPA Guidelines.

Table 6.1: Material Assets and typical topics

Material Asset	Typical Topics to be Covered
Roads & Traffic	Construction Phase Operational Phase Unplanned Events (i.e. Accidents)
Built Services	Electricity Telecommunications Gas Water Supply Infrastructure Sewerage
Waste Management	Construction Waste Operational Waste

Based on a review of the Proposed Development and the suggested topic areas set out in the EPA guidelines (2022), consideration of the projects impact on Material Assets provided within this Chapter is discussed in the context of built services and waste management. This includes electricity supply and infrastructure, aviation, television and telecommunications, water supply and wastewater infrastructure and waste management. The impact on Roads & Traffic is assessed separately in Chapter 5 – Material Assets - Traffic & Transportation of this EIAR.

The methodology used for this study included consultation and desk-based research of published information on the relevant potentially impacted material assets. A summary of consultation with respect to the potential impact on Television, Telecommunications and Air Navigation from the development is provided in Table 6.2. Full responses from consultees are included in Volume III - Appendix 6-1.

The method of impact assessment and prediction follows the EPA (2022) Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR). The assessment methodology as per the EPA guidelines is outlined in Chapter 1 Introduction of this EIAR.

Table 6.2: Summary of Consultations

Consultee	Response date	Impact Identified by Consultee
Irish Aviation Authority (IAA)	03/03/2023	No Impact Identified
Broadcasting Authority of Ireland (BAI)	16/02/2023	No Impact Identified
Commission for Communications Regulation (ComReg)	03/04/2023	Provided a list of organisations and contacts relevant to telecommunications. No comments on impacts provided.

Consultee	Response date	Impact Identified by Consultee
2rn (RTE Transmission Network)	17/02/2023	No Impact Identified, however there may be a risk of interference to broadcast services in the area. A signed protocol will be signed between the developer and 2rn.
ESB Telecoms	17/02/2023	No Impact Identified
Imagine Communications Ireland Ltd	20/02/2023	No Impact Identified
Tetra Ireland Communications Ltd	27/03/2023	No Impact Identified
Airspeed (now Magnet+)	No response received to date	Not applicable
BT Communications Ireland	No response received to date	Not applicable
Eir	No response received to date	Not applicable
Three Ireland	No response received to date	Not applicable
Virgin Media	17/02/2023	No Impact Identified
Vodafone	20/02/2023	No Impact Identified

6.3. Baseline Conditions

6.3.1. Electricity Supply and Infrastructure

Existing electricity infrastructure in the vicinity of the Proposed Development includes the 110kV Connemara overhead line, the Knockranny (West Galway) 110kV substation and the recently constructed Ardderroo windfarm110kV substation.

The 110kV Connemara overhead line is approximately 48km in length and runs from Salthill to Screeb substation. The application was granted in December 2009 by An Bord Pleanála. The overhead line is located to the east of the Proposed Development area and is located approximately 769 metres from the nearest turbine location.

The Knockranny/West Galway, 110kV Electricity Substation is a 110/38kV electricity substation in the townland of Letter., which was granted planning permission by An Bord Pleanála to Eirgrid plc in October 2013 under Pl. 07VA0016, to facilitate the connection of wind farm developments that have accepted their grid connection offers in West Galway to connect to the national grid. The substation has been constructed and has been energised as part of the national grid.

The Ardderroo wind farm 110kV substation has been recently constructed as part of the nearby Ardderroo wind farm. The substation was granted permission by An Bord Pleanála under PA07.303086 and 308302. The connection from this substation to the National Grid is via the Knockranny/West Galway 110kV substation via underground cabling connection. The Knockalough wind farm and Galway Wind Park (GWP) also connect to the national grid via underground cabling connection to the Knockranny (Galway West) Substation and the Proposed Development underground cabling connecting to Ardderroo substation will interact with those cables.

6.3.2. Aviation

Airports are valuable transport, tourism, employment, and business assets for the local and national economy. The development of large energy projects has the potential to impact air service and operations (airports, landing strips, etc.) within a project area. Developments around airports and under flight-paths can constrain operations, either directly where they conflict with safety/operational requirements, or indirectly where they interfere with radar or other navigational aids. The nearest airports with respect to the Proposed Development lands are listed in Table 6.3. The baseline conditions include the 11 turbines which were assessed as part of the EIS for the Permitted Development which identified that the project is unlikely to have adverse consequence for the safety of air navigation and no significant negative residual impacts to aviation are anticipated.

Table 6.3: Aviation Locations in the vicinity of the Proposed Development site

Radar	Location	Distance to nearest Turbine
Shannon Airport (Primary Surveillance Radar only)	County Clare	76km
Galway Airport	County Galway	18km
Connemara Airport	County Galway	24km
Inis Mór Aerodrome	County Galway	37km
Inishmaan Aerodrome	County Galway	34km
Inisheer Aerodrome	County Galway	35km

6.3.3. Television and Telecommunications

RTE's analogue service was turned off in October 2012 and was replaced by a new Digital Terrestrial Television (DTT) service, commonly known as Saorview TV. The digital Saorview service is still provided from the large RTE transmission sites and a number of new transmission sites have also been built. A review of the Saorview coverage map indicates that TV reception in the area is principally received from MAGHERA transmitter located 56 km to the south east as shown in Figure 6.1. TV reception in other area surrounding the site is received from the following transmitters:

- Areas north of the site receive TV reception from the north via the transmitter at Castlebar, County Mayo.
- Area's northeast and east of the site receive TV reception from the northeast via the transmitter at Truskmore, County Sligo or from the north via the transmitter at Castlebar, County Mayo.
- Areas southeast and south of the site receive TV reception from the southeast via the transmitter at Maghera, County Clare.
- Areas to the west of the site receive TV reception from the southeast via the transmitter at Maghera, County Clare or from the southwest via the transmitter at Casla, Co. Galway

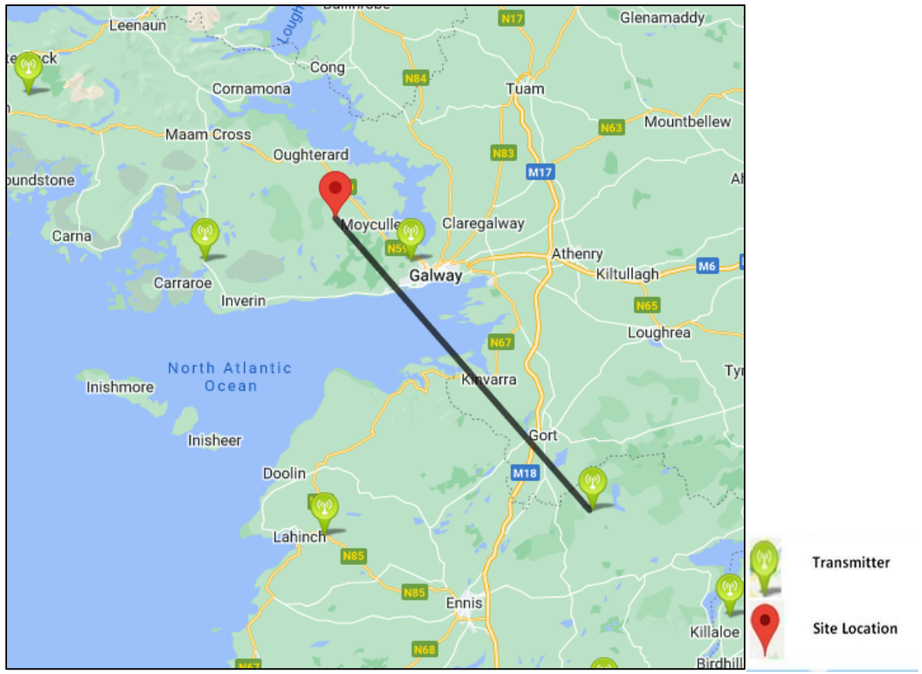

Figure 6.1 TV Transmitters in proximity to Knockranny, Co. Galway (https://saorview.ie/en/check-coverage/)

The Saorview coverage map also indicates that Saorview service coverage is currently a challenge in some areas surrounding the Proposed Development site, as shown in Figure 6.2.

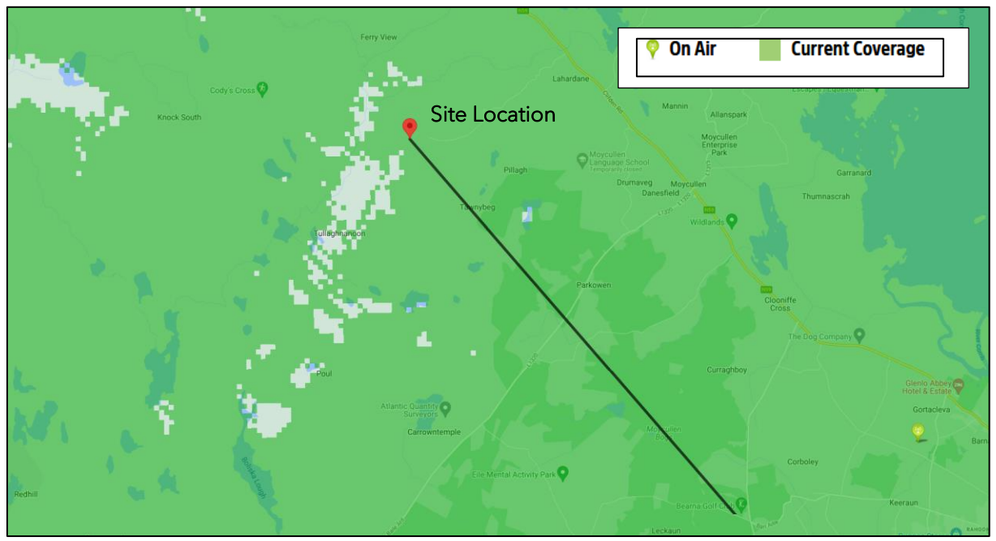

Figure 6.2 Saorview Coverage in proximity to Knockranny, Co. Galway (https://www.saorview.ie/en/get/coverage)

A review of the Commission for Communications Regulation (ComReg) Site Viewer Service Map shows that mobile network operators with masts and communication links in the area include Meteor (now known as eir Mobile), Vodafone, Three and Imagine Communications Ireland. Figure 6.3 shows Telecommunication infrastructure in the vicinity of the Proposed Development site.

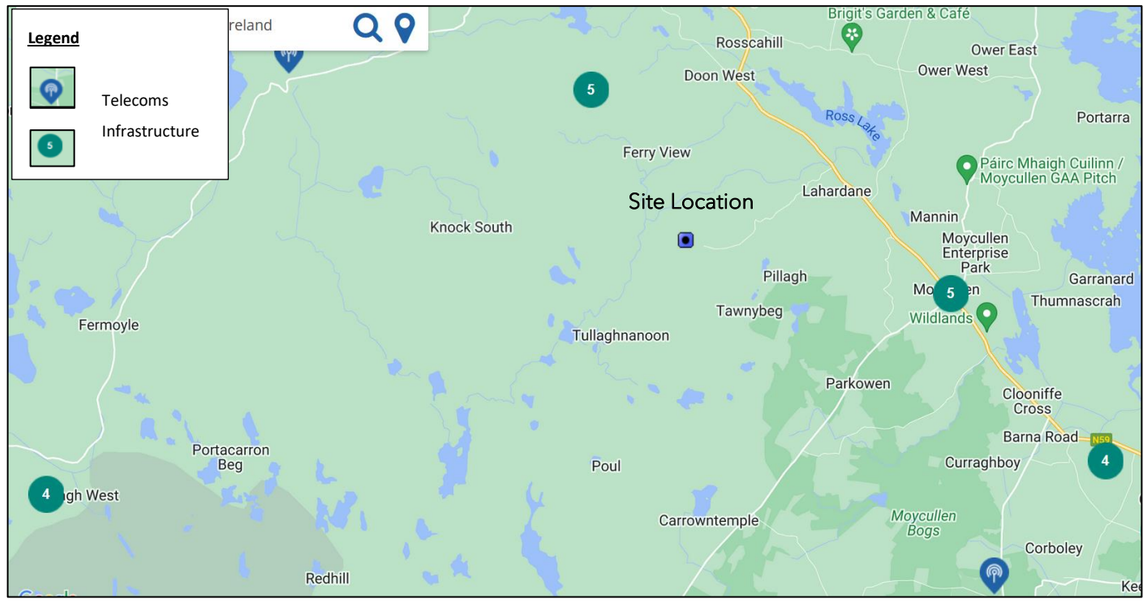

Figure 6.3 Telecommunications Infrastructure in the vicinity of Knockranny (ComReg SiteViewer)

The closest telecommunication masts are located approximately 2.3km north of the Proposed Development. There are five masts located at this location. Details pertaining to these masts are summarised in Table 6.4.

Table 6.4 Telecommunication Mast details

	Site ID				
	3_GA0289	THREE_GA0289	GY046	4035	GY112
Easting	113652	113652	113648	113649	113652
Northing	237197	237197	237190	237196	237197
Latitude	53.38	53.38	53.38	53.38	53.38
Longitude	-9.3	-9.3	-9.3	-9.3	-9.3
Operator	Three	Three	Imagine Communications Ireland Ltd	Meteor (eir Mobile)	Vodafone
Services	UMTS, LTE, NR	GSM, LTE	LTE	GSM, UMTS, LTE, NR	GSM, UMTS, LTE

A desk study and pre-planning consultation with known communication link operators was undertaken to establish the number of communication links in the vicinity of the Proposed Development. Based on the desk study, the operators outlined in Table 6.5 were believed to operate communication links in the area and were thus consulted. The EIS for the Permitted Development concluded that the communication providers consulted indicated that there would be no likely impact to their communication links as a result of the proposed wind farm development.

Table 6.5: Telecommunications Operators Consulted

Telecommunications Operators
Airspeed
Broadcasting Authority of Ireland (BAI)
BT Communications Ireland
Eir (Eircom Ltd.)
ESB Telecoms
Imagine Communications Ireland Ltd
Meteor Mobile Communications (now Eir Mobile)
2rn (RTE Transmission Network)
Three Ireland
Tetra Ireland Communications (emergency services)
Virgin Media
Vodafone

6.3.4. Water Supply and Wastewater Infrastructure

There is currently no public wastewater or water supply infrastructure within the Proposed Development site.

Water supply at the Ardderroo substation is provided by rainwater harvesting systems for sanitary facilities. Bottled water is supplied for drinking.

Wastewater from the staff welfare facilities at the Ardderroo substation will be collected in a sealed storage tank, with all wastewater being tankered off site by permitted waste collector to wastewater treatment plants. The wastewater storage tank will be fitted with an automated alarm system that will provide sufficient notice that the tank requires emptying. The proposed extension to the Ardderroo substation will not require additional welfare facilities and the existing system is considered to be appropriate.

6.3.5. Waste Management Services

A desk study of available information from the EPA did not identify any waste facilities within a 2km radius of the wind farm site. The nearest waste facilities to the Proposed Development site are shown in Figure 6.4.

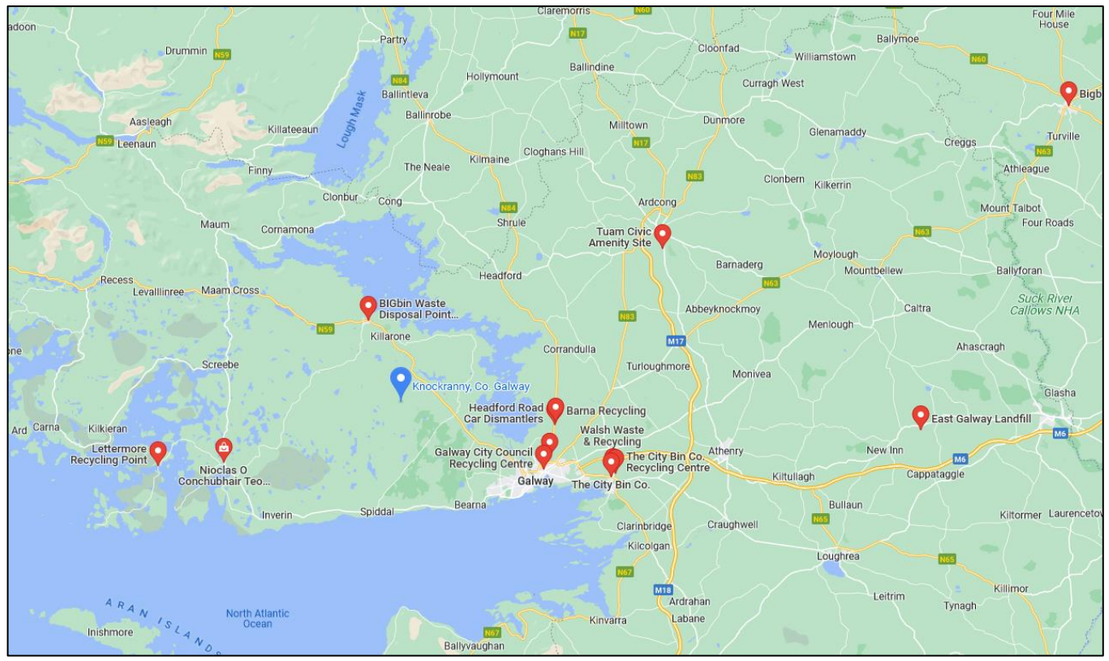

Figure 6.4 Known Waste Facilities near Knockranny (www.nwcpo.ie)

6.4. Likely Significant Impacts

Likely significant effects of the proposed project on Material Assets – Services, Infrastructure and Utilities are discussed below.

6.4.1. Do Nothing Scenario

In consideration of the 'do nothing' scenario on the site, the implementation of the Permitted Development would proceed unamended and the proposed increase in overall energy capture of between 14 – 16 MW per annum would not be achieved.

The 'do-nothing' scenario would also result in the unnecessary construction of an on-site substation and associated environmental impacts.

This would result in a *negative slight likely long-term impact*.

6.4.2. Assessment of Effects During Construction

6.4.2.1. Electricity Supply and Infrastructure

During the construction phase, electricity to the Proposed Development site compound will be supplied using onsite generators. Therefore, no additional power demands on the existing network are likely and will result in a *neutral, imperceptible, likely, temporary effect* on the existing electricity supply.

To facilitate a connection to the National Electricity Grid the Proposed Development incudes *underground electrical and communications cabling connecting the 11 no. wind turbines to the Ardderroo substation, as well as extension to substation control building and new step up transformer.* Existing underground electrical cables in the vicinity of the Proposed Development have been identified and avoided. Therefore, potential impacts to existing underground electrical infrastructure will be avoided.

The Proposed Development includes an extension to the Ardderroo substation comprising IPP control building extension (c.75 m^2), additional transformer, transformer bund and associated electrical equipment and plinths. This new infrastructure will be completely within the confines of the Ardderroo substation and its compound and thus will have no impact to other existing electricity supply infrastructure. This results in a *neutral* and *negligible* effect on the existing electricity supply network.

6.4.2.2. Aviation

There will be no potential impacts to aviation during the construction phase.

6.4.2.3. Television and Telecommunications

There will be no impacts to television and telecommunications during the construction phase.

6.4.2.4. Water Supply and Wastewater Infrastructure

There will be no likelihood for a significant impact to public water supply or wastewater infrastructure during the construction phase.

Water supply during the works will be provided by means of imported bulk water tanks and separately drinking water for employees will be provided delivered bottled water. The construction phase will also avail of rainwater collection from the roofs of temporary buildings which then can be stored and used for washing and cleaning of plant at dedicated wash out locations.

Concrete will be batched off site and delivered to site in ready mix concrete trucks. Concrete truck will be allowed to wash chutes on-site but barrel washout will take place at their own depot. The trucks have their own on board water tanks for ready-mix watering and for washing down of chutes so water requirements are minimised.

Bulk water tankers will also bring bulk water supply to site which will then be stored in tanks within the temporary compound for use during the construction phase. As per the Permitted Development, wastewater generated during the construction phase from welfare facilities at the windfarm temporary site construction compound, will drain to integrated wastewater holding tanks. The stored effluent will then be collected on a regular basis from site by a permitted waste contractor and removed to a licensed/permitted waste facility for treatment and disposal.

There are 6 no. of EPA licensed/certified Wastewater Discharge facilities within 20km of the Proposed Development site. These include but are not limited to Moycullen Wastewater Plant (WWTP) 8km southeast, Oughterard WWTP 8km north, Spiddal WWTP 13km to the south, Headford WWTP 17km northeast, Galway WWTP 20km southeast and as well as other WWTPs in the surrounding area.

Overall, the construction activities will result in a neutral, imperceptible, temporary effect on the water supply and wastewater infrastructure.

6.4.2.5. Waste Management

During the course of the construction phase, a certain amount of waste will be produced. There will be no new or additional waste streams generated by the Proposed Development to that of the already Permitted Development.

As with the Permitted Development no excavated soils, subsoils, or bedrock will require disposal outside the boundaries of the proposed windfarm development lands. With the exception of peat soils, excavated materials from all construction activities will be stockpiled at hardstand locations during construction and subsequently reused on site for regrading or revegetation. Excavated peat will be stored within a designated peat deposition area. The peat storage area is an existing area of cutover bog and has been chosen for its low peat instability risk, low lying recessed area of ground, and suitable topography. It has been confirmed in Chapter 7 that the area has the capacity to accommodate the additional peat arising from the Proposed Development.

Other construction phase waste may consist of hardcore, concrete, spare steel reinforcement, cable wires, shuttering timber and building materials. This waste will be stored in the construction compound and collected at the end of the construction phase and taken off site to be reused, recycled and disposed of in accordance with best practice procedures at an approved facility. Plastic waste will be taken for recycling by an approved contractor and disposed or recycled at an approved facility. Hazardous materials, such as fuels and lubricant oils, used during construction that require disposal will be disposed of in accordance with all applicable laws and regulations. Domestic type waste generated by contractors will be collected on site, stored in an enclosed skip at the construction compounds and disposed of at a licensed landfill facility. Table 6.6 outlines some known waste facilities which are approved to accept these waste streams and may be utilised.

Overall the types of wastes to be generated will be similar to established construction waste streams and will not require unusual or new treatment options. Waste volumes will not be significant as to require new permitted treatment, storage and disposal facilities as there is sufficient capacity at licensed disposal or recycling facilities in proximity to the Proposed Development, see Figure 6.3. Waste Management procedures have been included in the CEMP in EIAR Volume III - Appendix 2-1.

This would result in a *neutral, not significant, temporary impact* on waste management facilities.

Table 6.6: Sample of Authorised Waste Facilities

Waste Type	EWC code	Facility	Location
Domestic Wastewater	20 03 04	Bruscar Bhearna Teo	Carrowbrowne Headford Rd Co. Galway
		Garry Regan	Furbo Connemara Co. Galway
		Comhlacht Iompar Clochmor Teo	Clochmór Baile na Habhann Co. Na Gallimhe
C&D waste	17 01 07	Bruscar Bhearna Teo	Carrowbrowne Headford Rd Co. Galway
		Enva Ireland Limited	Clonminam Industrial Estate Portlaoise Co. Laois
		McTigue Quarries Ltd.	Belclare Tuam Co. Galway
		The City Bin Co. Unlimited Company	Oranmore Business Park Oranmore Co. Galway
Waste oils	13 02 08	Clare Drains Environmental Ltd	Unit 10 Abbey Business Park Quin Road Ennis Co. Clare
		Enva Ireland Limited	Clonminam Industrial Estate Portlaoise Co. Laois
		Clean (Irl) Refuse & Recycling Co. Unlimited Company	Ballinagun Cree Kilrush Co. Clare
Domestic waste	20 03 01	Bruscar Bhearna Teo	Carrowbrowne Headford Rd Co. Galway
		Galway Metal Company Ltd	Oranmore Co. Galway H91 V96X
		Walsh Waste Ltd	Deerpark Industrial Estate Oranmore Galway H91 RH31
Oil interceptors	13 05 01 13 05 02 13 05 03 13 05 06 13 05 08	Walsh Waste Ltd	Deerpark Industrial Estate Oranmore Galway H91 RH31
		Enva Ireland Limited	Clonminam Industrial Estate Portlaoise Co. Laois

6.4.3. Assessment of Effects During Operation

6.4.3.1. Electricity Supply and Infrastructure

The Proposed Development does not pose a risk to the existing local electricity infrastructure. Communication from the ESB provides that the clearance distance between any wind turbine on the site and the 110kV line should not be less than 3 times the rotor diameter of a turbine. The separation distances of the nearest wind turbines to the nearby overhead satisfy this requirement. As outlined in Section 6.3.1 the minimum distance between the 110kV line and any proposed turbine is 769m with a maximum required separation distance of 414m.

The proposed increase in overall turbine height to 150m will result in enhanced efficiency and will facilitate an increased generating capacity in the order of 14 to 16 MW.

The proposed change will complement the national grid development strategy and will contribute to the reduction of greenhouse gas emissions and Ireland's commitment to meet EU and national emissions targets. The proposal will assist in meeting increases in electricity demand nationally by exporting electricity into the electricity market. It will contribute to ensuring that adequate electricity supplies are available to support economic activity and growth in a manner fully compatible with Government energy and environmental policies.

Overall the Proposed Development will result in a *positive, moderate, likely, long term* effect on electricity supply. The Proposed Development will contribute directly and in the long term to the electricity network by strengthening it through additional renewable energy generation.

6.4.3.2. Aviation

The Proposed Development is located within an area which has several operational wind farms nearby. Consultation with the IAA confirmed that that the Proposed Development will not have any material impact on aviation. Therefore, anticipated effects on aviation during the operational phase as a result of the Proposed Development are considered to be *neutral, not significant, long-term*.

6.4.3.3. Television and Telecommunications

Responses received from the telecommunications providers indicate that there would be no likely impact on their communication links. This study was unsuccessful in obtaining a response from a number of telecommunication providers (Airspeed (now Magnet+), BT Communications Ireland, Eir and Three Ireland) and subsequently is not conclusive in determining if certain communication links are likely to be affected by the proposed wind farm. These networks were assessed as part of a previous wind farm application on these lands and the development was not considered to have negative impacts to these links. It is anticipated that any potential interference with links can be suitably overcome. Suitable mitigation, if required, would need to be carried out in consultation with the operations provider.

Correspondence from Broadcasting Authority of Ireland (BAI) has indicated that they are not aware of any issues from existing wind farms with existing Frequency Modulation (FM) networks. Furthermore, the Proposed Development is not located close to any existing or planned FM transmission sites.

As noted in Figure 6.2, Saorview service coverage is currently a challenge in some areas surrounding the Proposed Development site. Correspondence from 2rn has indicated that the probability of interference from the Proposed Development in the context of interference to Saorview television reception for viewers in the vicinity of Knockranny is deemed to be "very low". Notwithstanding this, as is standard practice, a signed Protocol between

the developer and 2rn will be put in place, in which the developer will be responsible to resolve any issue of interference with television reception as a result of the Proposed Development (see EIAR Volume III - Appendix 6-2 for signed protocol).

All correspondence relating to this issue has been included in EIAR Volume III - Appendix 6-1.

Any impacts on TV and Telecommunication reception in areas can be suitably addressed under the agreement between the applicant and any affected Telecommunication provider.

6.4.3.4. Water Supply and Wastewater Infrastructure

No public water supply or wastewater utility infrastructure is required at the wind farm site.

There are existing welfare facilities at the Ardderroo 110kV substation. No additional water supply or wastewater utilities will be required as a result of the Proposed Development. Therefore, there will be no impact on water supply and wastewater infrastructure during the operational phase.

6.4.3.5. Waste Management

The operational aspect of the Proposed Development would produce a minimal amount of waste. Wastes arising from the general operation and maintenance would principally include residual lubricating oils, cooling oils, mineral oils, packaging from spare parts. The wastes will all be removed from site and reused, recycled or disposed of in an authorised facility in accordance with best practice. Potential facilities are listed in Table 6.8. There will be no new or additional waste streams generated by the Proposed Development to that of the already Permitted Development. Waste volumes will not be significant as to require new permitted treatment, storage and disposal facilities.

Table 6.7: Permitted/Licensed Waste Facilities

Waste Type	EWC code	Facility	Location
Domestic Wastewater	20 03 04	Bruscar Bhearna Teo	Carrowbrowne Headford Rd Co. Galway
		Garry Regan	Furbo Connemara Co. Galway
		Comhlacht Iompar Clochmor Teo	Clochmór Baile na Habhann Co. Na Gallimhe
Waste oils	13 02 08	Clare Drains Environmental Ltd	Unit 10 Abbey Business Park Quin Road Ennis Co. Clare
		Enva Ireland Limited	Clonminam Industrial Estate Portlaoise Co. Laois
		Clean (Irl) Refuse & Recycling Co. Unlimited Company	Ballinagun Cree Kilrush Co. Clare
Domestic waste	20 03 01	Bruscar Bhearna Teo	Carrowbrowne Headford Rd Co. Galway
		Walsh Waste Ltd	Deerpark Industrial Estate Oranmore Galway H91 RH31
Oil interceptors	13 05 01 13 05 02 13 05 03 13 05 06 13 05 08	Walsh Waste Ltd	Deerpark Industrial Estate Oranmore Galway H91 RH31
		Enva Ireland Limited	Clonminam Industrial Estate Portlaoise Co. Laois
		McBreen Environmental Drain Services Ltd	Lismagratty Cootehill Road Co. Cavan

The effects of waste management are considered to be *negative, moderate, local, likely, permanent.*

6.4.4. Assessment of Effects During Decommissioning

On decommissioning about 85% of turbine components, including steel, copper wire, electronics and gearing, can be recycled or reused. The fibreglass blades however are difficult to recycle and currently are generally disposed of by landfill. There are existing options available to developers for blade reuse and recycling in the form of artificial reefs, playgrounds or street furniture, cement co-processing for the glass fibre component, and blade recycling through pyrolysis and gasification (Wind Europe, 2017). The recycling of turbine blades is currently the subject of significant research focus, and it is envisaged that at the end of the wind farm lifespan the recycling of all turbine parts will be commonplace. The approach to decommissioning will be confirmed based on best practice at the time. A decommissioning plan is contained in the CEMP in EIAR Volume III - Appendix 2-1.

This would be negative impact of the development and likely to require provision of new treatment technologies and/or facilities. Therefore, the effects of waste management during decommissioning phase are considered to be *negative, moderate, local, likely, permanent.*

No other significant impacts on Material Assets – Services, Infrastructure and Utilities are envisaged during the decommissioning stage of the Proposed Development.

6.5. Mitigation Measures and Monitoring

6.5.1. Construction Phase

6.5.1.1. Electricity Supply and Infrastructure

Mitigation by design has been adopted whereby the grid connection methodology has been selected to ensure no significant effects on existing electrical infrastructure.

Prior to construction confirmatory drawings for all existing services will be sought upon consultation with ESB Networks and other stakeholders.

Immediately prior to construction taking place, the area where excavation is planned will be re-surveyed by CAT scan (sub-surface survey technique to locate any belowground utilities) and all existing services will be verified. Temporary warning signs will be erected.

Clear and visible temporary safety signage will be erected all around the perimeter of the live work area to visibly warn members of the public of the hazards of ongoing construction works.

The as-built location of the installed ducts will be surveyed and recorded using a total station/GPS before the trench is backfilled to record the exact location of the ducts. The co-ordinates will be plotted on as-built record drawings for the Proposed Development operational phase.

6.5.1.2. Aviation

No impacts to aviation are likely during the construction phase. No mitigation required.

6.5.1.3. Television and Telecommunications

No impacts to television and telecommunications are likely during the construction phase. No mitigation required.

6.5.1.4. Water Supply and Wastewater Infrastructure

Wastewater that will be generated during the construction phase will be managed by the installation of a temporary integrated waste holding tank.

All wastewater to be taken off-site is to be undertaken by an authorised waste contractor and brought to an authorised waste facility.

6.5.1.5. Waste Management

Waste will be managed in accordance with the waste hierarchy in Council Directive 98/2008/EC on waste and section 21A of the Waste Management Act 1996, as amended, as follows:

(a) Prevention; (b) re-use; (c) Recycling; (d) Other recovery (including energy recovery); and (e) Disposal.

Waste generation is principally avoided through planning and management of activities and good housekeeping. The procurement of material inputs is generally in bulk. By bulk procurement, the generation of small-sized containers and packaging is largely avoided and thus minimises the generation of unnecessary waste requiring recycling or disposal.

In line with the Waste Hierarchy, wherever possible, packaging will be returned to originator. All waste for offsite treatment/disposal is to be stored temporarily in appropriate dedicated storage areas. The areas in which wastes are stored on site are segregated to prevent material and contaminated surface water runoff entering local surface water drains.

All chemical, hydrocarbon or other controlled wastes will be stored in designated areas in appropriate approved containers within bunds or on spill pallets, as required.

All waste to be removed from site will be undertaken by authorised waste contractors and transported to an authorised facility in accordance with best practice and the site waste management plan as discussed in the CEMP (EIAR Volume III - Appendix 2-1).

6.5.2. Operational Phase

6.5.2.1. Electricity Supply and Infrastructure

There is no anticipated effect upon the grid network outside of the infrastructure for the Proposed Development itself. The Proposed Development will provide a positive effect on the electricity supply infrastructure. No specific mitigation measures are proposed.

6.5.2.2. Aviation

Whilst the Proposed Development will not impede aircraft, IAA Electronic Air Navigation Obstacle Data sets have identified obstacles as objects whose height above ground level is 90m or higher, affecting air navigation. Irish Wind Energy Association (IWEA) Guidelines have set out the following measures to ensure that pilots of aircraft are fully aware of the presence of wind turbines:

- All turbines and meteorological masts having a height of 90m or more are promulgated in the Irish Air Navigation Obstacle database;
- Wind turbines or any structure exceeding 90m in height may require appropriate aviation warning lighting as agreed with IAA;
- The IAA should be informed 30 days in advance of the erection of any structure exceeding 45m in height.

Having regard to the above:

- The developer will agree an aeronautical obstacle warning light scheme for the wind farm development with the IAA;
- The developer will provide the IAA with as-constructed coordinates in WGS84 format together with ground and tip height elevations at each wind turbine location;
- The developer will notify the IAA of intention to commence crane operations with a minimum of 30 days prior notification of turbine erection.

6.5.2.3. Television and Telecommunications

In the event of interference to television and telecommunication services arising from the Proposed Development the applicant is committed to work with telecommunication providers to remedy any issues of interference to affected communication links. If required, appropriate mitigation measures can be implemented such that there will either be an imperceptible effect, or no effect, on surrounding reception as a result of the Proposed Development, with the solution to interference with TV reception or communication links dependent on where the residence receives signal from.

As standard practice, a signed Protocol between the developer and 2rn will be put in place, in which the developer will be responsible to resolve any issue of interference with television reception as a result of the Proposed Development.

6.5.2.4. Water Supply and Wastewater Infrastructure

No mitigation is required for Water Supply and Wastewater Infrastructure as part of the Proposed Development.

6.5.2.5. Waste Management

All waste for offsite treatment/disposal is to be stored temporarily in appropriate dedicated storage areas. The areas in which wastes are stored on site will be segregated to prevent material and contaminated surface water runoff entering local surface water drains.

All chemical, hydrocarbon or other controlled wastes will be stored in designated areas in appropriate approved containers within bunds or on spill pallets, as required.

All waste to be removed from site will be undertaken by authorised waste contractors and transported to an authorised facility.

6.5.3. Decommissioning Phase

Mitigation measures proposed during the construction phase will also be implemented during the decommissioning phase. As no additional significant effects are assessed as likely to occur during the decommissioning phase no specific mitigation measures are proposed or required. All tall structures will be removed, and no significant effects are assessed as likely on telecommunications, television or aviation. The approach to decommissioning will be confirmed based on best practice at the time. A decommissioning plan will be agreed with Galway County Council three months prior to decommissioning the Proposed Development. A decommissioning plan is contained in the CEMP in Volume III - Appendix 2.1. Decommissioning phase effects are assessed to be similar to those of the construction phase but of a reduced scale and magnitude. Consequently, it is assessed that the decommissioning phase will not give rise to any likely significant effects.

6.6. Residual Effects

Residual effects section outlines the degree of environmental change that will occur after the proposed mitigation measures have taken effect.

6.6.1. Construction Phase

6.6.1.1. Electricity Supply and Infrastructure

During the construction phase, electricity to the proposed development site compound will be supplied using onsite generators. Therefore, no additional power demands on the existing network are likely and will result in a neutral, imperceptible, likely, short-term effect on the existing electricity supply.

6.6.1.2. Aviation

The effects on aviation associated with the construction activities are considered to be *neutral, imperceptible, likely, short-term.*

6.6.1.3. Television and Telecommunications

The effects on television and telecommunications associated with the construction activities are considered to be *neutral, imperceptible, likely, short-term.*

6.6.1.4. Water Supply and Wastewater Infrastructure

The effects on water supply and wastewater infrastructure associated with the construction activities are considered to be *neutral, imperceptible, likely, short-term.*

6.6.1.5. Waste Management

The level of waste generated on site will be minimal. Overall, the effect on waste management facilities is considered a *negative, not significant, local, likely, short-term impact* during the temporary construction phase of the works.

6.6.2. Operational Phase

6.6.2.1. Electricity Supply and Infrastructure

The overall effects on electrical supply and infrastructure are considered to be *positive, moderate, likely, long term.*

6.6.2.2. Aviation

The residual effects on aviation operations anticipated as a result of the Proposed Development are considered to be *neutral, not significant, long-term.*

6.6.2.3. Television and Telecommunications

The residual effects on television services or telecommunication services are considered to be *neutral imperceptible long-term* as a result of the proposed wind farm development.

6.6.2.4. Water Supply and Wastewater Infrastructure

The residual effects on water supply and wastewater infrastructure assets are considered to be *neutral, imperceptible, long-term* as a result of the Proposed Development.

6.6.2.5. Waste Management

The level of operational waste generated on site will be minimal. All wastes will be appropriately managed. It is considered a *negative, slight, occasional impact*.

6.6. Cumulative Effects

The cumulative effects of the Proposed Development have been assessed with existing, planned and permitted developments in the surrounding area identified in Section 1.10 of this EIAR.

6.7.1. Construction Phase

6.7.1.1. Electricity Supply and Infrastructure

There will be no cumulative impacts relating to the Development and surrounding projects in relation to electricity networks during the construction phase as electricity to the Proposed Development site compound will be supplied using onsite generators. Therefore, no additional power demands on the existing network are likely. The new infrastructure will be completely within the confines of the Ardderroo substation and its compound and thus will have no impact to other existing electricity supply infrastructure.

6.7.1.2. Aviation

Any large project that holds the potential to effect Aviation, the Developer of that project is responsible for engaging with all relevant Aviation Authorities to ensure that the proposals will not interfere with radio signals by acting as a physical barrier. In the event of any potential impact, the Developer for each individual project is responsible for ensuring that the necessary mitigation measures are in place. Therefore, as each project is designed and built to avoid impacts arising, a cumulative impact cannot arise.

6.7.1.3. Television and Telecommunications

Consultation with television and telecommunication providers indicates that the Proposed Development is unlikely to have a significant effect on these services. As with any project that holds the potential to effect television and telecommunications, the Developer of that project is responsible for engaging with all relevant providers to ensure that the proposals will not interfere with radio signals by acting as a physical barrier. In the event of any potential impact, the Developer for each individual project is responsible for ensuring that the necessary mitigation measures are in place. Therefore, as each project is designed and built to avoid impacts arising, a cumulative impact cannot arise.

6.7.1.4. Water Supply and Wastewater Infrastructure

During the construction stage no public water supply or wastewater utility infrastructure is required for the Proposed Development. The volumes of water used and wastewater requiring disposal are minimal and will have a negligible impact on the capacities of external treatment facilities. Therefore, cumulative effects on water and waste water infrastructure are unlikely during the construction stage.

6.7.1.5. Waste Management

During the construction stage waste volumes will not be significant as to require new permitted treatment, storage and disposal facilities as there is sufficient capacity at licensed disposal or recycling facilities in proximity to the Proposed Development. The types of waste to be generated will be similar to established construction waste streams and will not require unusual or new treatment options. Therefore, cumulative effects are unlikely during the construction stage.

6.7.2. Operational Phase

6.7.2.1. Electricity Supply and Infrastructure

Potential negative cumulative effects on electricity networks are unlikely during the operational phase.

The proposed wind farm has been designed to have no negative effect on any Electricity Supply Infrastructure. Therefore, there will be no negative cumulative impact between the Proposed Development and other existing, permitted or proposed wind energy, infrastructural or other developments in the wider area but will provide a potentially positive, moderate, likely, permanent effect on the electricity supply in the area.

6.7.2.2. Aviation

Potential negative cumulative effects on aviation are unlikely during the operational phases.

The proposed wind farm has been designed to have no negative effect on any aviation links or networks. Therefore, there will be no cumulative impact between the proposed wind farm development and other existing, permitted or proposed wind energy, infrastructural or other developments in the wider area.

6.7.2.3. Television and Telecommunications

Potential negative cumulative effects on television and telecommunications are unlikely during the operational phases.

The proposed wind farm has been designed to have no negative effect on any Television and Telecommunications links or networks. Therefore, there will be no cumulative impact between the proposed wind farm development and other existing, permitted or proposed wind energy developments, infrastructural or other developments in the wider area.

6.7.2.4. Water Supply and Wastewater Infrastructure

No public water supply or wastewater utility infrastructure is required at the Proposed Development site therefore it is unlikely that any cumulative effects will arise.

6.7.2.5. Waste Management

During the operational phase, waste volumes will be minimal and as there is sufficient capacity at licensed disposal or recycling facilities in proximity to the Proposed Development, potential negative cumulative effects on waste management infrastructure are unlikely.

6.7.3. Decommissioning Phase

The Proposed Development is not likely to result in any cumulative effects on Material Assets - Services, Infrastructure and Utilities either individually or in combination with other existing, permitted or Proposed Developments.

6.7. Difficulties Encountered in Compiling Information

Responses to consultation were not received from all stakeholders consulted.

6.8. References

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CNOC RAITHNÍ (KNOCKRANNY) WIND FARM

CHAPTER 7

Land and Soils

VOLUME II EIAR

CHAPTER 7 – Land & Soils

CONTENTS

Chapter 7

7. LAND & SOILS

7.1. Introduction

The objective of this chapter is to consider the impacts to the land and soils of the Proposed Development at the Cnoc Raithní (Knockranny) Wind Farm development at Knockranny, located approximately 9 kilometres southwest of Oughterard, in County Galway. This assessment determines if any significant impacts or effects are anticipated and if these effects can be mitigated to ensure the project does not adversely impact on the environment. A detailed description of the Proposed Development is outlined and presented in Chapter 1 and Chapter 2 of this EIAR.

7.1.1. Permission Granted under Planning Application Reg. Ref. 13/829 and PL07.243094 for the Cnoc Raithní (Knockranny) Wind Farm Development

The Environmental Impact Statement ("EIS") submitted for the "Permitted Development", states the proposed wind farm location is not a sensitive site in terms of the geological environment and the wind farm was designed to eliminate or minimise any impact on the peat environment with aims to restore and enhance a portion of the bog. The Permitted Development does not constitute a significant negative effect on the environment.

7.1.2. Proposed Development

The development for which planning permission is now being sought from Galway County Council comprising specified proposed alterations to the Permitted Development, including the proposed turbine alterations, underground electrical and communications cabling connecting the 11 no. wind turbines to the Ardderroo substation, as well as extension to substation control building and new step up transformer (as described in detail under Section 2.3 of this report).

7.1.3. Objectives

This chapter of the EIAR provides a baseline assessment of the environmental setting of the Proposed Development site, as described in detail in Chapter 2 of this EIAR, in terms of land, soils and geology and discusses the potential likely significant effects and cumulative effects that the construction, operation and decommissioning of the Proposed Development will have. A cumulative assessment is also undertaken. Where required, appropriate mitigation measures to avoid any identified significant effects to land, soils, geology and natural resources are recommended and the residual effects of the Proposed Development are assessed.

In this regard, the assessment aims to:

- To review and characterise the baseline soils and geological conditions of the existing environment within each study area.
- To evaluate the impact of the design for the Project on these attributes and establish the activities associated with the construction and operation of the proposed development.
- To address interactions with other disciplines.
- To identify and assess any potential impacts on any geological heritage sites or sites of geological interest.
- To identify and incorporate appropriate mitigation measures, which would prevent, reduce or remediate the identified impact.
- To conclude any residual impacts that would remain or arise from the mitigation measures identified.

7.2. Assessment Methodology

The assessment has been undertaken in accordance with the 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Schemes' (National Roads Authority (now TII), 2009) and the Environmental Protection Agency (EPA), Institute of Geologists of Ireland (IGI) and European Commission environmental impact assessment guidance:

- EPA (2022) 'Guidelines on Information to be contained in Environmental Impact Assessment Reports
- IGI (2013) 'Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements'
- Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report (European Commission, 2017)

7.2.1. Impact Evaluation Methodology

Contained within the Irish Statute Book (ISB) Schedule 6 of the Planning and Development Regulations (ISB, 2001) a description of the aspects of the environment likely to be significantly affected by the proposed development is required on '*soil, water, air, climatic factors and the landscape*'.

Impacts may be categorized as one of three types:

- Direct Impact - the existing geological environment along or in close proximity to the route corridor is altered, in whole or in part, as a consequence of construction and/or operation.
- Indirect Impact - the geological environment beyond the proposed route corridors is altered by activities related to construction and/or operation.
- No Predicted Impact - the proposed route corridor has neither a negative nor a positive impact on the geological environment.

In accordance with the TII Guidelines, the rating criteria for assessing the importance of geological features within the study area are outlined in Table 7-1.

Table 7-1: Criteria for Geological feature Importance Rating (TII)

Importance	Criteria
Very High	Attribute has a high quality, significance or value on a regional or national scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and / or soft organic soil underlying development is significant on a national or regional scale.

Importance	Criteria
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and / or soft organic soil underlying development is significant on a local scale.
Medium	Attribute has a medium quality, significance or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and / or soft organic soil underlying development is moderate on a local scale.
Low	Attribute has a low quality, significance or value on a local scale. Degree or extent of soil contamination is minor on a local scale. Volume of peat and / or soft organic soil underlying development is small on a local scale*.

*relative to the total volume of inert soil disposed of and/or recovered

The rating criteria for quantifying the magnitude of impacts is outlined in Table 7-2. These impact ratings are in accordance with impact assessment criteria provided in the EPA Guidelines and the IGI Guidelines. The criteria apply to potential impacts during both the construction and operational phases.

Table 7-2: Estimation of Magnitude of Impact on Soils/Geology Attribute (TII)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute	Loss of high proportion of future quarry or pit reserves Irreversible loss of high proportion of local high fertility soils Removal of entirety of geological heritage feature Requirement to excavate / remediate entire waste site Requirement to excavate and replace high proportion of peat, organic soils and / or soft mineral soils beneath alignment
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Loss of moderate proportion of future quarry or pit reserves Removal of part of geological heritage feature Irreversible loss of moderate proportion of local high fertility soils Requirement to excavate / remediate significant proportion of waste site Requirement to excavate and replace moderate proportion of peat, organic soils and / or soft mineral soils beneath alignment
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Loss of small proportion of future quarry or pit reserves Removal of small part of geological heritage feature Irreversible loss of small proportion of local high fertility soils and / or high proportion of local low fertility soils Requirement to excavate / remediate small proportion of waste site Requirement to excavate and replace small proportion of peat, organic soils and/or soft mineral soils beneath alignment
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	No measurable changes in attributes
Minor Beneficial	Results in minor improvement of attribute quality	Minor enhancement of geological heritage feature
Moderate Beneficial	Results in moderate improvement of attribute quality	Moderate enhancement of geological heritage feature
Major Beneficial	Results in major improvement of attribute quality	Major enhancement of geological heritage feature

Table 7-3: Estimation of Significance of Impact on Attribute (TII)

Importance of Attribute	Magnitude of Impact			
	Negligible	Small adverse	Moderate Adverse	Large Adverse
Very high	Imperceptible	Significant/Moderate	Profound/Significant	Profound
High	Imperceptible	Moderate/Slight	Significant/Moderate	Profound/Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/Moderate

7.3. Consultation

A number of statutory and non-statutory consultees were contacted to ascertain any commentary or observations in relation to the project. Details are provided in Table 7-4.

Table 7-4: List of Statutory Consultees contacted

Degree/Nature	Description	Addressed in Chapter Section
Geological Survey of Ireland (GSI)	Geological Heritage should be considered. No County Geological Sites in in the vicinity of the proposed wind farm development. **(1)** The Groundwater Data Viewer indicates an aquifer classed as a 'Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones' underlies the proposed wind farm development. **(2)** The Landslide Susceptibility Map indicates there are some areas of Moderately High to High Landside Susceptibility in the EIAR study area. **(3)** We would recommend use of the Aggregate Potential Mapping viewer to identify areas of High to Very High source aggregate potential within the area **(4)** GSI request a copy of reports detailing site investigations to be carried out.	Geological Heritage Section 10.4. Geological Heritage Areas Section 10.4. Mineral/Aggregate Resources Section 10.4. Hydrogeology Section 10.4. Landslide Potential

7.4. Baseline Conditions

Various data sources have been consulted throughout this assessment. These include:

- Permitted Development Environmental Impact Statement including:
  - Chapter 8, Soils and Geology, 'Cnoc Raithni (Knockranny) Wind Farm Proposal.
  - Malachy Walsh and Partners, "Peat Stability Report for the proposed Cnoc Raithni (Knockranny) Wind Farm Development. Doc No. 15047-6001-A.
- GSI Spatial Viewer (https://dcenr.maps.arcgis.com) for information on soils, geology and hydrogeology
- Irish Geological Heritage Programme of the GSI (https://www.gsi.ie/en-ie/programmes-and-projects/geoheritage/Pages/default.aspx)
- Ordnance Survey of Ireland online historic mapping and aerial photographs GeoHive (https://www.map.geohive.ie);
- The Office of Public Works (OPW) (www.opw.ie)
- Environmental Protection Agency (EPA) (https://gis.epa.ie)
- National Parks & Wildlife Service (http://www.npws.ie/);

7.5. Regional Overview

The proposed development site is in a rural area in the townlands of Knockranny, Letter and Ardderroo. This is located west of the N59 National Secondary Road, between Moycullen and Ougherard, in Co. Galway. The site is located 3km southwest of Roscahill village, 4.5km northwest of Moycullen village, 9km south of Oughterard town, and 15km northwest of Galway City.

The EIAR study area includes a total of 331ha, situated at the western end L-5348 coming from N59 to the east at the townland of Oghtery in the east. Ross Lake is located approximately 3km east of the proposed site. The proposed new connection to the National Grid is via underground cabling to the Ardderoo substation to the northwest of the Permitted Development.

7.5.1. Regional Geomorphology and Topography

The landscape was greatly formed and influenced by the glaciation periods. In particular, during the last glaciation when the ice dome overlying the eastern area of Galway moved south-westwards, it shaped the terrain and deposited till and erratics as it melted. The erratics at the Knockranny site range in size from minor rocks strewn across the hills and surface to larger granite boulders.

The Proposed Development site is located in gentle hilly terrain, northwest of Moycullen and west of Ross Lake. Within the site, the height ranges from approximately 80m 180m OD. The topography of the site is undulating with two peaks within the site, one to the west at 134m OD and one to the east at 183m OD (Knockranny Hill). The remaining land slopes at varying degrees from these summits to the relatively flat ground of the lower slopes.

The regional topography is a combination of hills and low lying areas with lakes, rivers and streams. Newtown Hill lies approximately 3km to the east and stands at 198mOD. Two hills to the south at Letterncaska have summits of 159m OD and 156 m OD, and are between 0.5 to 1km south of the Knockranny site. At Doon, 2km north of the site, there is a 209m OD peak and there is a peak of 227m OD approximately 2km northwest in Letter. The hills slope and drain down to the lower lying areas.

Land use within the site, and in the general area, includes forestry, agriculture and turbary. A large tract of forestry occurs to the west of the site, while peat bogs occur to the north and south, with increased agricultural activity to the west. The Ardderroo Wind Farm is currently under construction to the west of the proposed site. Evidence of past settlement and farming activity is evident within the site to the west and east marked by old field boundaries. The site is currently grazed by cattle and sheep. In the past, peat cutting has taken place within the site and a series of drains were also excavated.

7.5.2. Quaternary Geology

Quaternary Geology are superficial deposits of quaternary-aged material which overlie the bedrock geology across most of the site. The GSI online mapping service (GSI, 2023) identifies the site as comprising generally peat with some localised outcropping of bedrock. To the eastern side of the side there are areas where the till is derived from granites. The quaternary sediments across the site are presented in Figure 7.1.

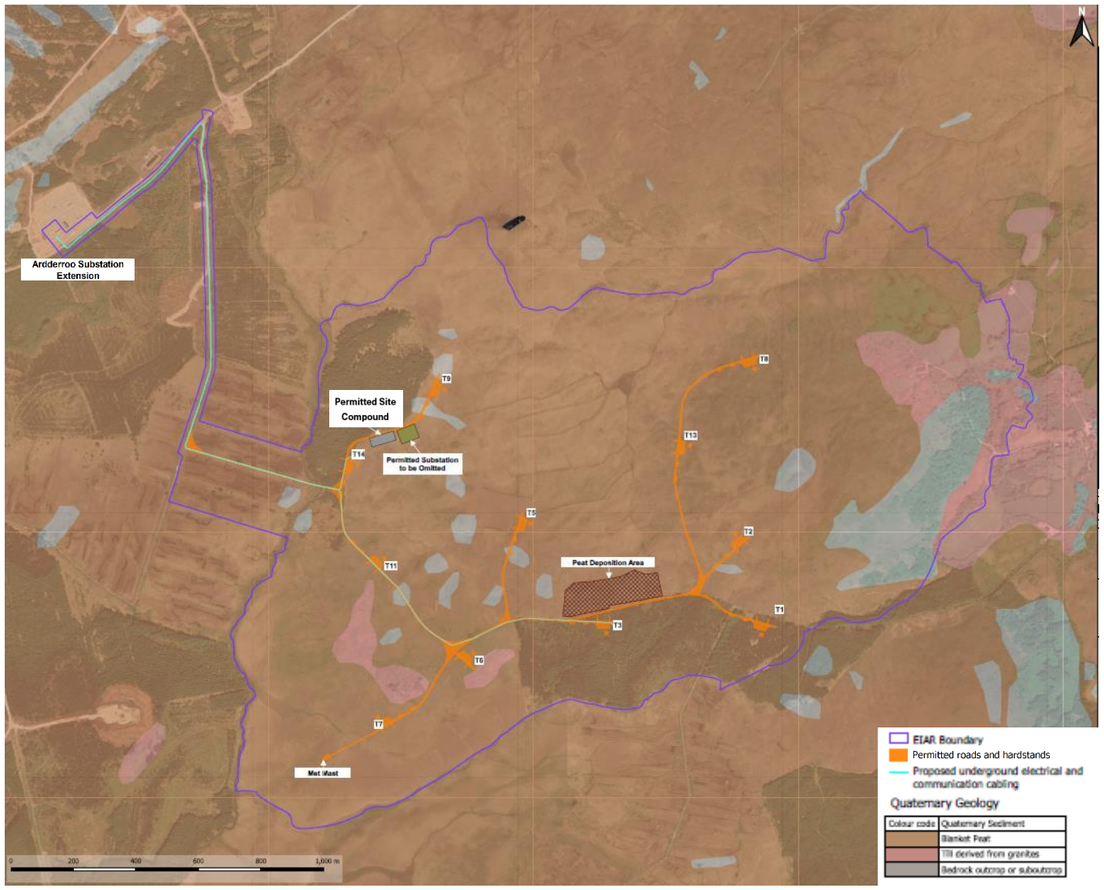

Figure 7.1 Quaternary sediments at the Knockranny Wind Farm site location

7.5.3. Bedrock geology

The GSI online mapping service (GSI, 2023) identifies the bedrock geology across the site as a Porphyritic-Megacrystic Granite which is part of the Porphyritic Megacrystic Granite (Galway Granite) formation. The lithological description of this unit by the GSI (2023) is "phenocrysts up to 80mm in longest dimension and is commonly foliated." The bedrock geology across the site is presented in Figure 7.2.

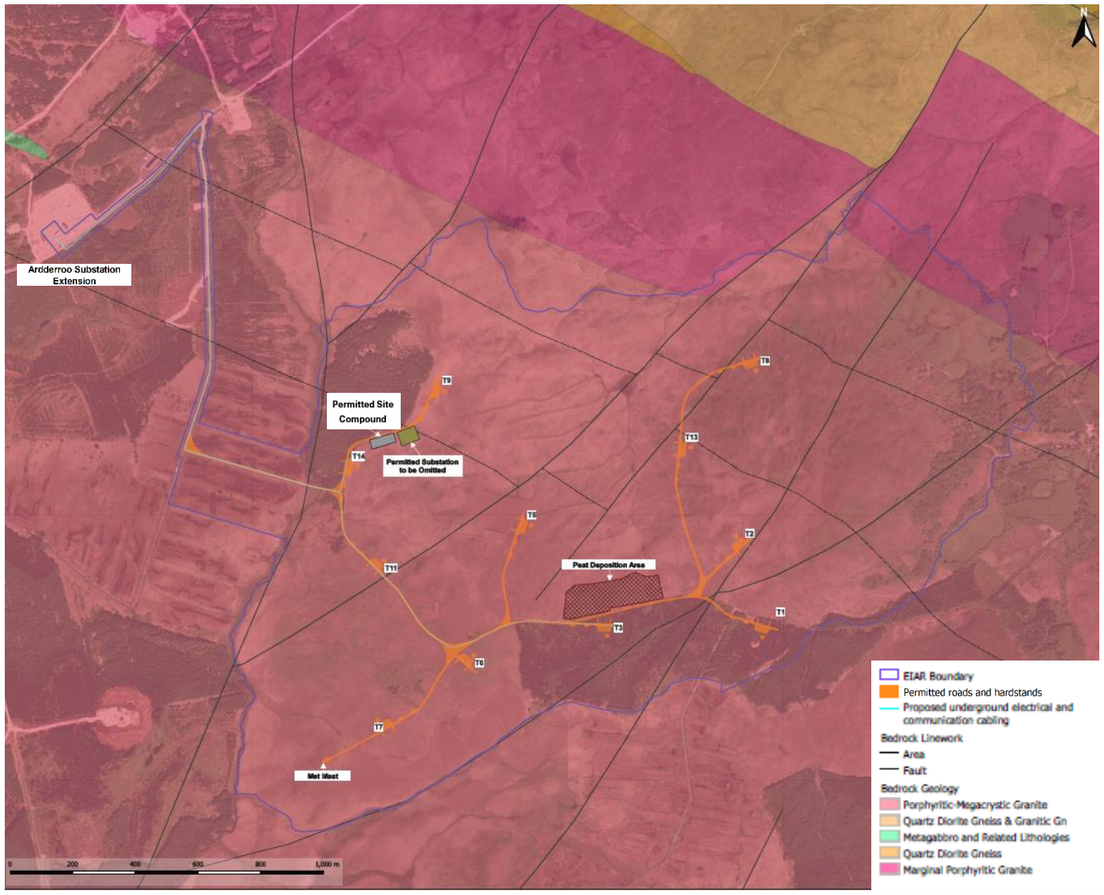

Figure 7.2 Bedrock geology at the Knockranny Wind Farm site location

7.5.4. Soft or Unstable Ground

Soft and/or unstable deposits within the study area consist of peat. Soft deposits were identified along the Proposed Development from a desktop assessment of the Quaternary Geology (see Section 7.5.2). A geotechnical and peat stability assessment was carried out by J. B. Barry & Partners Limited (2023) for the Proposed Development site. The findings of this peat assessment showed that the Proposed Development site has an acceptable margin of safety, is suitable for the proposed wind farm development and is considered to be at low risk of peat failure.

7.5.5. Mineral/Aggregate Resources

There are several quarries, both historic and operating, in proximity to the proposed wind farm site in Co. Galway. Any quarries employed during the construction phase will have appropriate permits to allow extraction. Details of local quarries are identified below; however, this list is not intended as an exhaustive one, but demonstrates a sample of known geological resources;

- Walsh Quarries Ltd., Derrynea, Costelloe, Galway (granite);
- Maam Cross Quarries, Galway (granite);
- M & M Quarries Ltd., Moycullen, Galway (limestone);
- Kynes Sand & Gravel, Moycullen, Galway (sand and gravel); and
- Lackagh Quarries Coolough, Menlo, Galway.

There is also a concrete supplier Corke Concrete, located in Moycullen. Larger suppliers in the greater area and region include Lackagh Concrete, Coshla Quarries, and Roadstone.

Consultation with the GSI database shows there are numerous mineral sites recorded (due to the presence of granite) including recorded occurrences of Pyrite and the Knockranny locality. The recorded location is outside the proposed site, to the southeast. If a metallic mineral is identified on site during the construction, its presence will be notified to the GSI for their records. No commercial extraction of the metallic minerals will be permitted under contracts placed with the landowner and the contractors who construct the development.

7.5.6. Geological Heritage Areas

A national inventory of geoheritage sites known as County Geological Sites (CGSs) is managed by the Geoheritage Programme of Geological Survey Ireland.

The GSI was consulted with information on the project as part of the EIAR process. In response to the consultation, the GSI confirmed that there are no CGSs in vicinity of the Proposed Development. Therefore, impacts associated with geological heritage areas have not been further considered in the assessment

7.5.7. Karst

No karst features were identified proximal to the proposed site according to the GSI database. The area is predominantly granite (as shown in Figure 7.2), therefore, impacts associated with karstification have not been further considered in the assessment.

7.5.8. Contaminated Land

There is no evidence of contaminated land along the proposed development from baseline data sources, ground investigation surveys, or walkover surveys. There are no waste-licensed facilities within the study area. Therefore, impacts associated with contaminated land have not been further considered in the assessment.

7.5.9. Landslide Susceptibility

The GSI online mapping service (GSI, 2023) provides landslide susceptibility mapping across the subject site. The landslide susceptibility mapping was overlaid with the site layout and is presented in Figure 7.3. Figure 7.3 shows that turbine locations are classified as follows:

- High landslide susceptibility classification – T8;
- Moderately high landslide susceptibility classification – T13, T11, T13;
- Moderately low landslide susceptibility classification – T2, T5, T6, T7, T9, T14 ; and
- Low landslide susceptibility classification – T1, T3.

Turbine T8 has been identified by the GSI as being in an area of high landslide susceptibility due to the localised presence of higher slope angles, which shall be managed effectively at the detailed design stage. The findings, of the geotechnical and peat stability assessment carried out by J. B. Barry & Partners Limited (2023), showed that the Proposed Development site has an acceptable margin of safety, is suitable for the proposed wind farm development and is considered to be at low risk of peat failure.

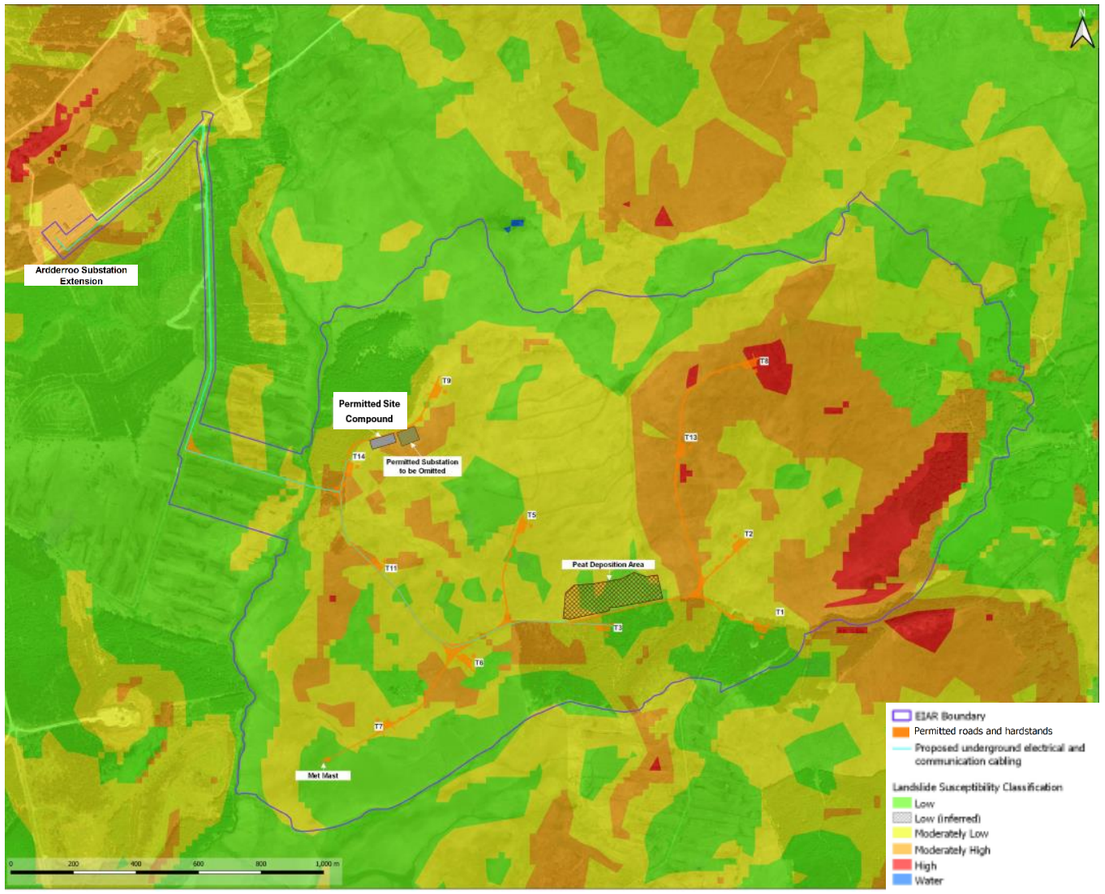

Figure 7.3 Landslide susceptibility mapping at the Knockranny Wind Farm site location

7.5.10. Groundwater Vulnerability

The vulnerability classification within the vicinity of the Proposed Development site is shown in Figure 7.4. Generally the site is classified for groundwater vulnerability as extreme or rock at or near surface. The proposed underground electrical and communications cabling connecting the 11 no. wind turbines to the Ardderroo substation is classified as high vulnerability. Groundwater vulnerability classification is not a measure of the impact on groundwater quality but rather the degree of protection afforded to the underlying aquifer and consequently the risk to the groundwater quality in the event of a release of a contaminant. The GSI classification of the vulnerability of an aquifer is based on the thickness and the permeability of overburden. The greater the thickness and permeability, the greater the protection to the groundwater in the underlying aquifer. High and extreme vulnerable subsoils are a feature underlying a high proportion of the proposed development.

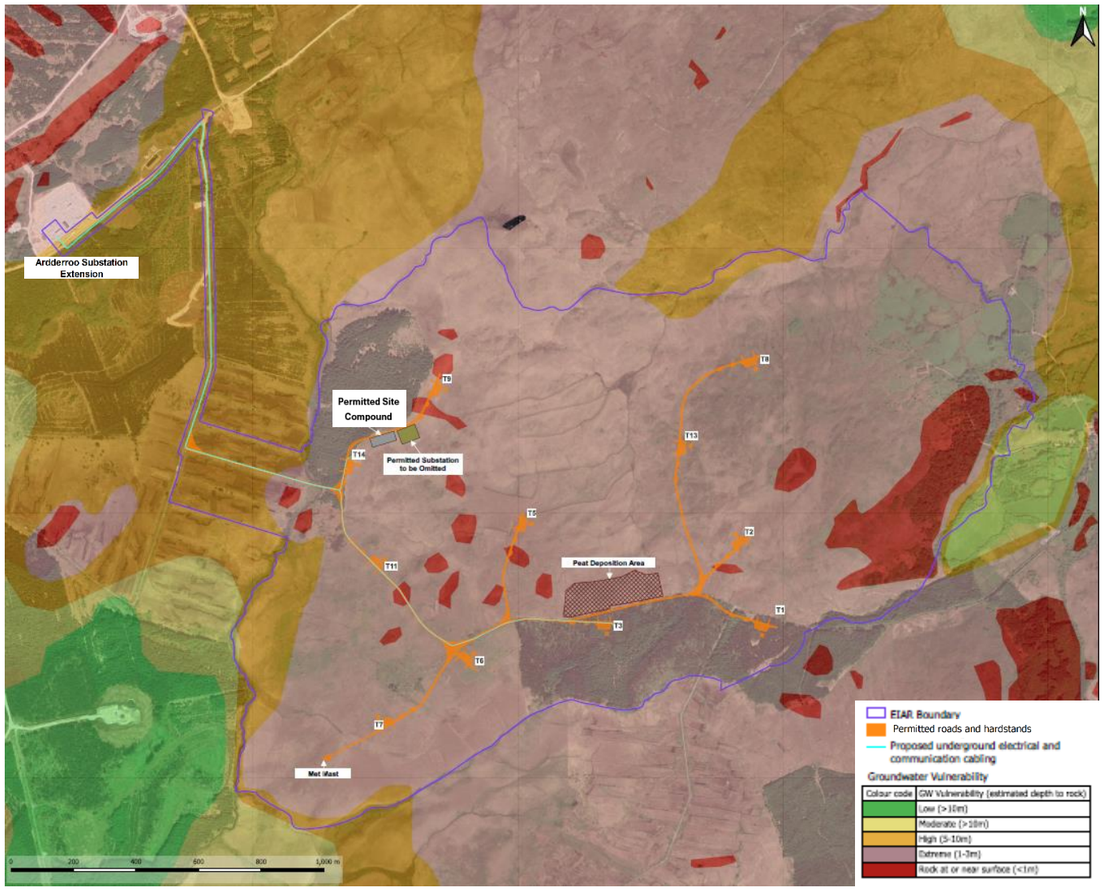

Figure 7.4 Groundwater vulnerability mapping at the Knockranny Wind Farm site location

7.5.11. Characteristics of Peat at the Site

According to the peat assessment completed (JBB,2023), the peat is characterized by "brown to black, firm to extremely soft, fibrous to amorphous peat". Site investigations were carried out in 2010, from late 2012 to 2013 and recently in January 2023. The peat was found to be generally "wet to saturated" which is often a function of precipitation and water saturation.

During site investigations, a total of 1,041 peat probes or gouge cores were completed at the site. Results from the site investigation indicated a humification range of H2 to H10. Overall, the site is characterized by moderate to higher humification rates. The Von Post Humification Scale is a 10-point scale ranging from H1 unhumified to H10 totally humidified plant remains or amorphous peat.

Blanket peat covers most of the site; with the exception of areas of rock outcropping and close to Knockranny Hill to the east. The site investigation results indicate a peat depth range from nominal depths (0.1m) to approximately 5m across the study area. Whilst there was no large-scale turf cutting at the site, there are several isolated turf banks in some areas. A geotechnical and peat stability assessment was carried out by J. B. Barry & Partners Limited (2023) for the Proposed Development site.

7.5.12. Summary of the Peat Stability Risk Assessment Report

The infrastructure has been systematically placed in areas of low peat depths. The topographical slopes in the site are identified by the GSI as low to high. Turbine T8 has been identified by the GSI as being in an area of high landslide susceptibility due to the localised presence of higher slope angles, which shall be managed as outlined in the peat stability register for T8 in Appendix F of the geotechnical and peat stability assessment (JBB, 2023).

The findings, of the geotechnical and peat stability assessment carried out by J. B. Barry & Partners Limited (2023), showed that the Proposed Development site has an acceptable margin of safety, is suitable for the proposed wind farm development and is considered to be at low risk of peat failure.

Overall, the systematic placing of items of infrastructure in areas of low peat slide susceptibility and maximized use of existing roads and topographical features has resulted in a layout of insignificant risk of peat slide.

7.6. Likely Significant Impacts

7.6.1. Characteristics of the Proposed Development

The Proposed Development will result in the following construction activities:

- Ground excavations at the increased wind turbine foundations;
- Increase in peat material to be deposited in the permitted peat deposition area;
- Provision of underground electrical and communications cabling connecting the wind turbines to the Ardderroo substation, including a new cable service track and widening of an existing access road;
- Extension of the Ardderroo substation within the existing compound, including a new transformer and building extension.
- Importation of additional stone fill material due to the increase in the size of the turbine base, and cabling service track and road widening; and
- Omission of the substation from the Permitted Development

7.6.2. Do Nothing Scenario

The do nothing scenario is considered to be the construction of the Permitted Development *at the subject site*. No significant impacts were noted for the land and soils from the *Permitted Development* Environmental Impact Statement (EIS)Assessment of Effects During Construction.

The Proposed Development consists of the following elements to be completed during construction of the wind farm;

- An increase in turbine foundation size to accommodate the larger turbines; underground electrical and communications cabling connecting the 11 no. wind turbines to the Ardderroo substation with associated road widening and new access track; Extension to the Ardderroo Substation within the existing compound including extension to substation control building and a new step up transformer; Tree felling; site drainage. (As described under Section 2.3 of this report).

7.6.2.1. Geology

Importation of Construction Materials

The Proposed Development will require the additional importation of approximately 1,350m^3 of structural fill material for the wind turbine foundations. This impact is considered to be of neutral quality, imperceptible significance and have a short-term duration.

The upgrading of the existing forestry road to tie in with the existing Arrderroo Wind Farm access road will require approximately 2,900m^3 of material.

The trenching through the existing Arrderroo Wind Farm access road will require approximately 300m^3 of material.

The off road section of cabling track to the south of the existing Arrderroo Substation access road will require approximately 2,000m^3 of material.

Overburden & Bedrock Removal

There will be an additional 2,000m^3 of non peat material excavated due to the increase in wind turbine foundation size, it is considered that this material is suitable to be re-used on site. The removal of soil during excavation works is a direct and permanent impact on the overburden of the proposed development. The overall magnitude of this potential impact is negligible (TII, 2008) and would be classified under the EPA guidelines as having a neutral effect, of imperceptible significance and permanent duration.

The omission of the permitted on-site Substation will result in a reduction in excavation to the Permitted Development of approximately 400m^3 of material.

Erosion, Storage & Stockpiles

Earthworks surfaces will be temporarily exposed during the excavation of foundation bases and at the access roads. These earthworks surfaces are subject to erosion if left exposed over a long period of time. The impact is classified as having a negative quality, moderate significance, and temporary duration.

The Proposed Development includes some additional tree-felling around some turbines and a small area of woodland across from the Ardderroo Substation to cater for the off-road cable service track. At a total of 2.45 hectares, this is not material in the context of felling already permitted on site. The impact is classified as having a negative quality, moderate significance, and permanent duration.

As there will be an additional 12,000m^3 of material being placed within the peat deposition area, stockpiled materials will be subject to erosion if left exposed over a long period of time. The impact is classified as having a negative quality, slight significance, and temporary duration. Further information is contained in Appendix 7-1, Section 6.4 of the Geotechnical and Peat Stability Assessment report (JBB, 2023) and the peat deposition area drawing (JBB, 2023a).

During construction, vehicles and plant will primarily use the access roads. Vehicle and plant movements have little potential to compact the subsoil. The magnitude of this potential impact is a negative effect, of imperceptible significance and of permanent duration.

Soil Pollution

During the construction phase, potential localised accidental spillages of fuel or chemicals on the site have the potential to contaminate the underlying soils by exposure, dewatering, or construction related spillages resulting in a Permanent Negative Impact on soils. The magnitude of this impact is small adverse as it may result in the

requirement to excavate/remediate a small proportion of contamination or result in a low risk of pollution to soils. As a result, its significance is moderate / slight for soil features.

7.6.3. Assessment of Effects During Operation

No new impacts will arise on the soil and lands environment during the operations phase of the project.

7.6.4. Assessment of Effects During Decommissioning

No new impacts will arise on the soil and lands environment during the decommissioning phase of the Proposed Development.

7.7. Mitigation Measures and Monitoring

7.7.1. Construction Phase

Mitigation measures for the construction phase include:

- Placement of turbines and associated infrastructure in areas with shallow peat during the design phase;
- Use of the existing road network to reduce peat excavation;
- The peat and subsoil which will be removed during the construction phase will be localised to the Proposed Development infrastructure; and
- No turbines or related infrastructure will be constructed near or on any designated sites such as NHAs or SACs.

7.7.2. Erosion, Storage & Stockpiles

Mitigation measures for the erosion, storage and stockpiles include:

Peat removed from turbine locations and access roads will be used for landscaping, where it can be placed alongside internal access roads or in the peat deposition area. Where possible, the acrotelm shall be stored with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation at the surface of the stored peat within the peat deposition area. Reseeding and spreading/planting of heather and moss cuttings will also be carried out in these areas. These measures will prevent erosion of stored peat in the long term.

Any excess temporary mounded peat in storage for long periods will be sealed using the back of an excavator bucket. This will prevent erosion of soil. Silt fences will be installed around stockpiles to limit movement of entrained sediment in surface water runoff. The use of bunds around earthworks and mounds will prevent egress of water from the works.

In order to minimize erosion of mineral subsoils stripping of peat will not take place during extremely wet periods as defined in the Chapter 8 of this EIAR (to prevent increased silt rich runoff). Temporary drainage systems will be required to limit runoff impacts during the construction phase.

During tree felling, brash mats will be used to support vehicles on soft ground, reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place when they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting.

7.7.3. Soil Pollution

Mitigation measures for soil pollution include:

- Minimal refueling or maintenance of construction vehicles or plant will take place on site. Off-site refueling will occur at a controlled fueling station;
- On site re-fueling will be undertaken using a double skinned bowser with spill kits on the ready for accidental leakages or spillages;
- On site re-fueling will be undertaken by suitably trained personnel only under a permit to refuel system;
- Fuels stored on site will be minimised. Storage areas located at the temporary compounds where required will be bunded appropriately for the fuel storage volume for the time period of the construction and fitted with a storm drainage system and an appropriate oil interceptor;
- The electrical substation will be bunded appropriately to the volume of oils likely to be stored, and to prevent leakage of any associated chemicals and to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose;
- An emergency plan for the construction phase to deal with accidental spillages is contained within the Construction and Environmental Management Plan; and
- Spill kits will be available to deal with accidental spillage in and outside the re-fueling area.

7.7.4. Peat Instability and Failure

Based on the recommendations and control measures given in the geotechnical and peat stability assessment report (JBB, 2023) being strictly adhered to during construction and the detailed stability assessment carried out for the peat slopes which showed that the site has an acceptable margin of safety, there is a low risk of peat instability/failure at the Proposed Development site.

The risk assessment at each turbine location identified a number of control measures to reduce further the potential risk of peat failure. Access roads to turbines will be subject to the same relevant control measures that apply to the nearest turbine as detailed in the geotechnical and peat stability assessment report (JBB, 2023).

The following measures which will be implemented during the construction phase of the project will assist in the management of the risks for this site.

- Appointment of experienced and competent contractors;
- The site will be supervised by experienced and qualified personnel;
- Allocate sufficient time for the project (be aware that decreasing the construction time has the potential to increase the risk of initiating a peat movement);
- Prevent undercutting of slopes and unsupported excavations;
- Maintain a managed robust drainage system;
- Prevent placement of loads/overburden on marginal ground as detailed in the peat stability assessment report;
- Set up, maintain and report findings from monitoring systems;
- Ensure construction method statements are followed or where agreed modified/developed; and,
- Revise and amend the Geotechnical Risk Register as construction progresses.

Please refer to the geotechnical and peat stability assessment report (JBB, 2023) for proposed turbine specific and road section mitigation measures.

7.8. Residual Effects

An overall analysis of the impacts, in the light of the proposed mitigation measures, concludes that all of the potential impacts (during construction, operational and decommissioning stages) are predicted to be reduced to neutral quality and Negligible magnitude under the Proposed Development.

The study concludes that from a land and soils perspective, the Proposed Development as described herein, has a nearly identical land and soils impacts with the Permitted Development and there is no significant residual impact to land and soils.

7.9. Cumulative Effects

7.9.1. Construction Phase

Cumulative impacts are the potential combined impacts from other developments in conjunction with the proposal. No significant cumulative effects have been identified during the peak construction phase under the Proposed Development and has a nearly identical cumulative impact as the Permitted Development. All identified developments within Section 1.10 from Chapter 1 have been considered.

7.9.2. Operational Phase

During the operational phase of the Proposed Development all aspects of the land, soils and geology environment will remain constant, with no alteration of any aspect of this environment. As a result, there will be no cumulative effects due to the Proposed Development. All identified developments within Section 1.10 from Chapter 1 have been considered.

7.9.3. Decommissioning Phase

During the decommissioning phase, there will be minimal disturbance of soil/subsoil. The underground electrical cabling ducting will be left in-situ and turbine bases will not be removed but covered over with soil/subsoil. These works will be limited in scale and similar to that of the Permitted Development and there is no potential for cumulative effects with other nearby developments. All identified developments within Section 1.8 from Chapter 1 have been considered.

7.10. Difficulties Encountered in Compiling Information

No difficulty was encountered in compiling information.

7.11. References

- J. B. Barry & Partners Limited (2023) – Geotechnical and Peat Stability Assessment. Doc. No: 22108-JBB-GE-XX-RP-CG-06007_Geotechnical_And_Peat_Stability_Assessment.
- J. B. Barry & Partners Limited (2023a) – Drawing no. 22108-JBB-ZZ-ZZ-DR-CG-06022. Drawing title: Peat Deposition Area (PDA).
- EPA (2015) 'Advice Notes for Preparing Environmental Impact Statements Draft'
- EPA (2022) 'Guidelines on Information to be contained in Environmental Impact Assessment Reports
- ISB (2001) 'S.I. No. 600/2001 - Planning and Development Regulations', Schedule 6.
- IGI (2013) 'Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements'
- Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report (European Commission, 2017)
- Galway County Development Plan (2022 – 2028) as published by the Galway County Council.

CNOC RAITHNÍ (KNOCKRANNY) WIND FARM

CHAPTER 8

Water

VOLUME II EIAR

CHAPTER 8 – Water

Contents

Chapter 8

8. WATER (HYDROLOGY & HYDROGEOLOGY)

8.1. Introduction

This chapter describes the existing hydrological characteristics at the Proposed Development site. The surface water features and characteristics are described, as well as the site drainage and groundwater. An impact assessment has been carried out to quantify the impact the Proposed Development poses to the hydrology and hydrogeological aspects of the environment and to propose mitigation measures to reduce any potential negative impacts.

It should be noted that the impacts on the aquatic ecology have been assessed in Chapter 9 of this EIAR.

Planning permission is being sought for modifications to the Permitted Development.

These modifications comprise;

- Alterations to the Permitted Development comprising the increase of the tip height from a maximum of 140.5m to 150m;
- The omission of the previously approved on-site substation and associated underground cabling;
- The development also includes the connection to the electricity grid including the laying of underground cables and connection to the Ardderroo substation. Electrical cables will extend from the permitted T3 and T14 wind turbines. Trenching to be undertaken within a forestry road (road to be widened), windfarm site and off-road service track to the south of the Ardderro substation road. The grid connection requires the extension of infrastructure to the Ardderroo substation comprising IPP control building, (c.75 m2) additional transformer and associated electrical equipment. See Section 2.3.6
- Amendments to the existing roadside artificial drainage measures;
- All ancillary works above and below ground necessary to facilitate the development.

A detailed description of the Proposed Development is outlined and presented in Chapter 2 of this EIAR.

The objectives of this assessment are:

- To review and characterise the baseline hydrological and hydrogeological conditions of the existing environment within the study area.
- To evaluate the impact of the Proposed Development on these attributes and establish the interactive activities associated with its construction, operation and decommissioning.
- To identify groundwater vulnerability to assess the impacts of the Proposed Development on the underlying aquifers, and any potential impacts on public/private water abstractions/wells.
- To address interactions with other disciplines (land and soils, ecology, waste.); whether there are likely to be any indirect impacts by changes in hydrology/hydrogeology on terrestrial and aquatic habitats that are designated and thus protected under Irish and European law.
- To identify and incorporate appropriate mitigation measures, that would prevent, reduce or remediate any identified impacts.
- To determine any residual impacts that would remain or arise from the mitigation measures identified.

8.2. Assessment Methodology

8.2.1. Guidance and Legislation

The guidance and legislation followed in compiling the EIAR is described in Chapter 1. The assessment described in this chapter has been undertaken in accordance with the 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' (National Roads Authority (now TII), 2009). It also has regard to the Environmental Protection Agency (EPA), Institute of Geologists of Ireland (IGI) and European Commission environmental impact assessment guidance:

This chapter has been prepared in accordance with the following Irish and European legislation.

- Environmental Impact Assessment Directive (EIA Directive) 2014/52/EU
- European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009) (as amended);
- European Communities (Water Policy) Regulations, 2003 (S.I. No. 722 of 2003) (as amended);
- European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. No. 278 of 2007);
- European Communities (Quality of Salmonid Waters) Regulations, 1988 (S.I. No. 293 of 1988);
- European Communities (Quality of Shellfish Waters) Regulations, 2006 (S.I. No. 268 of 2006) (as amended);
- Bathing Water Quality Regulations, 2008 (S.I. No. 79 of 2008);
- European Communities (Natural Habitats) Regulations, 1997 (S.I. No. 94 of 1997) and European Communities (Birds and Natural Habitats) Regulations, 2011 (S.I. No. 477 of 2011) (as amended);
- The EU Floods Directive 2007/60/EC;
- The EU Water Framework Directive 2000/60/EC;
- European Communities (Assessment and Management of Flood Risks) Regulations, 2010 (S.I. No. 122 of 2010) (as amended);
- The Planning System and Flood Risk Management Guidelines for Planning Authorities, OPW 2009; and
- Control of Water Pollution from Construction Sites- Guidance for Consultants and Contractors, CIRIA C532, 2001.

8.2.2. Consultation

Consultation was conducted with Environmental Protection Agency (EPA), Geological Survey of Ireland (GSI), Galway County Council (GCC) Water Services, Inland Fisheries Ireland and Carra Mask Corrib Water Protection Group, among other prescribed bodies. No project specific responses were received relevant to the hydrological and hydrogeological environment. Copies of consultation responses are included in Appendix 1.2 contained in Volume 3 of this EIAR.

8.2.3. Desktop Studies

Information on the Proposed Development, in the form of maps, databases and reports, was provided by the design team throughout the development of the Proposed Project. Hydrological and hydrogeological data were supplemented by the following online data from various websites and other sources

- Geological Survey of Ireland (GSI) online database and Map Viewers have been consulted (https://www.gsi.ie/en-ie/data-and-maps/Pages/default.aspx);
- EPA maps (https://gis.epa.ie/EPAMaps/); W FD classification for groundwater bodies
- Catchments.ie;
- Geological Survey of Ireland (GSI) 1:100,000 scale Bedrock Geology Map, Sheet 14 (Galway Bay);
- Teagasc soil mapping;
- Aerial Photographs;
- Historical mapping;
- Water quality assessment reports;
- River basin management plans;
- GSI Bedrock Geological Map of Ireland;
- Galway Council Development Plan 2016-2022

8.2.4. Field studies and Data Collection

The field studies undertaken comprised the following;

- Information gathered from Site investigation campaigns (peat probing) as part of the Land and Soils Assessment have been reviewed to determine the hydrogeological conditions of the proposed development site.
- A walkover survey of the site to identify hydrological features on site, wet ground, drainage patterns and distribution, exposures, drains etc,
- Collection of water samples for laboratory analysis to determine baseline water quality.

8.2.5. Impact Evaluation Methodology

According to Schedule 5 of the Planning and Development Regulations 2001, as amended, a description of the aspects of the environment likely to be significantly affected by the proposed development is required on 'soil, water, air, climatic factors and the landscape'.

The methodology adopted follows 'EPA (2022) 'Guidelines on the Information to be contained in Environmental Impact Assessment Reports'

Impacts may be categorized as one of three types:

- Direct Impact - the existing hydrological environment along or in close proximity to the proposed wind farm development is altered, in whole or in part, as a consequence of road construction and/or operation.
- Indirect Impact - the hydrological environment beyond the proposed wind farm development is altered by activities related to construction and/or operation.
- No Predicted Impact - the proposed wind farm development has neither a negative nor a positive impact on the geological, hydrological or hydrogeological environment.

The existing baseline environment was described in terms of its attributes. Data were gathered from desk studies, site visits and public consultation.

- In accordance with the TII 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' (Published by NRA 2009) the rating criteria for assessing the importance of hydrological and hydrogeological features within the study area are outlined in Table 8.1 and Table 8.2.
- The impacts of the Proposed Development (during both the Construction Phase and Operational Phase) on these attributes were described and considered in terms of duration, the proportion of the attribute that was impacted.
- The rating criteria for quantifying the magnitude of impacts is outlined in Table 8.3. These ratings are in accordance with impact assessment criteria provided in the EPA Guidelines and the IGI Guidelines.
- The significance of the impact was then assessed using the criteria in Table 8.4. The significance of an impact is based on the magnitude and the importance of the attribute being impacted.
- Mitigation measures to minimise these impacts were proposed and the residual impacts following mitigation were then reassessed.

The criteria apply to potential impacts during both the construction and operational phases.

Table 8.1 Criteria for Hydrogeological feature importance rating

Importance		Criteria	Typical Examples
Extremely High		Attribute has a high quality, significance or value on an international scale.	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. SAC or SPA status
Very High		Attribute has a high quality, significance or value on a regional or national scale	Regionally Important Aquifer with multiple wellfields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – e.g. NHA status. Regionally important potable water source supplying >2500 homes Inner source protection area for regionally important water source.
High		Attribute has a medium quality, significance or value on a local scale	Regionally Important Aquifer. Groundwater provides large proportion of baseflow to local rivers. Locally important potable water source supplying >1000 homes. Outer source protection area for regionally important water source. Inner source protection area for locally important water source.
Medium		Attribute has a medium quality or value on a local scale	Locally Important Aquifer Potable water source supplying >50 homes. Outer source protection area for locally important water source.
Low		Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer. Potable water source supplying <50 homes.

Table 8.2: Criteria for Hydrological feature importance rating

Importance	Criteria	Typical Examples
Extremely High	Attribute has a high quality, significance or value on an international scale.	River, wetland or surface water body ecosystem protected by EU legislation e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.
Very High	Attribute has a high quality, significance or value on a regional or national scale	River, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes Quality Class A (Biotic Index Q4, Q5)
High	Attribute has a medium quality, significance or value on a local scale	Salmon fishery Locally important potable water source supplying >1000 homes Quality Class B (Biotic Index Q3-4) Flood plain protecting between 5 and 50 residential or commercial properties from flooding Locally important amenity site for wide range of leisure activities
Medium	Attribute has a medium quality or value on a local scale	Coarse fishery Local potable water source supplying >50 homes Quality Class C (Biotic Index Q3, Q2- 3) Flood plain protecting between 1 and 5 residential or commercial properties from flooding
Low	Attribute has a low quality or value on a local scale	Locally important amenity site for small range of leisure activities Local potable water source <50 homes Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding Amenity site used by small numbers of local people

Table 8.3 Estimation of Magnitude of Impact on Hydrogeologic and Hydrologic Attributes

Magnitude of Impact	Criteria
Large Adverse	Results in loss of attribute
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity

Table 8.4 Estimation of Significance of Impact on Attribute

Importance of Attribute	Magnitude of Impact			
	Negligible	Small adverse	Moderate Adverse	Large Adverse
Extremely high	Imperceptible	Significant	Profound	Profound
Very high	Imperceptible	Significant/Moderate	Profound/Significant	Profound
High	Imperceptible	Moderate/Slight	Significant/Moderate	Profound/Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/Moderate

8.3. Baseline Conditions

8.3.1. Site Setting

The subject site is located approximately 4.5 kilometres north-west of the settlement of Moycullen and c.2.5 kilometres west of the N59 (Galway – Clifden) National Secondary Road. The site is accessed via county road from the N59 and a secondary road, from the north and west. The area in the vicinity of the site is a remote upland area interspersed with hills with rough grazing generally to the east, forestry, and turf cutting on bogland areas. To the north there are hills reaching 209mOD and 227mOD whilst to the north-west Knocknalee Hill reaches 291mOD. To the south-east Newtown Hill is 198mOD whilst to the south-west Tullaghnanoon reaches 169mOD.

A number of streams drain the site, one of which 'Sruthan Chnocan Raithni' traverses the subject lands. The 'Lough Adereen Stream', 'Abhainn na nArd Doiriu' and 'Sruthan Bui' occur along or near site boundaries. There are a large number of existing, permitted and proposed wind farms located within c. 10 km of the site located on a mix of bogland (mix of cutover and bog/heath habitat) and within commercial forestry plantations. The site is predominantly located immediately east of Ardderroo Wind Farm (25 turbines) which is under construction and overlaps the Ardderroo wind farm with the underground cabling connecting to the electricity grid at Ardderroo wind farm substation.

8.3.2. Hydrology

8.3.2.1. Catchments

The Proposed Development straddles two EPA delineated sub catchments:

- Ballycuirke Lough Stream_SC_010(30_14) within the greater Corrib catchment
- Owenboliska_SC_010(31_6) within the greater Galway Bay North catchment

Fig. 8.1 shows general flow direction from the Proposed Development into the relevant EPA sub-catchments.

Ballycuirke Lough Stream Sub-catchment: The Proposed Development site is drained generally northeastwards via upper headwaters of 'Sruthan Chnocan Raithní' (EPA name 'Knockaunranny') and the 'Lough Aderreen Stream' (EPA name 'Eochaire'), a tributary of Knockaunranny Stream. The Knockaunranny Stream flows into lower Ross Lake, discharging via Ballyquirke Lough Stream, Ballyquirke Lough and into Lough Corrib.

- **Owenboliska Sub-catchment:** The Proposed Development is described in Chapter 2 (section 2.3) and drains predominantly southwestwards via the 3rd order 'Abhainn na nArd Doiriú' (EPA un-named). A small 2nd order stream 'An Sruthán Bui' (EPA name 'Cnoc Raithní') flows along the southern site boundary confluencing with the Abhainn na nArd Doiriú. Two small, unnamed streams also join the Abhainn na nArd Doiriú, one draining the northwestern site boundary, nearest proposed T9, and one that is crossed by underground cabling on the proposed Grid Connection Route. The proposed grid connection route is described in Section 2.3.6. A further 1st order stream (EPA name 'Leitir') lies to the south of the Ardderroo substation, with surface drainage piped under the substation access road then flowing over low gradient topography towards this watercourse.

Figure 8.1 Location of Cnoc Raithní Wind Farm showing relevant EPA sub-catchments.

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Table 8.5 Summary of catchment details

Catchment	Size (km2)	Development area within catchment	Percentage catchment occupied by development	Percentage of development site in each catchment	Sub- catchment	Outfall
Corrib	3,112	1.616 km² / 161.6ha	0.05%	52%	2 (Sruthan Chnocan Raithni)	Abhain an Chnoic Bhain / Loch an Rosa / Lough Corrib
					3 (Lough Aderreen stream)	Abhain an Chnoic Bhain / Loch an Rosa / Lough Corrib

Owenaboliska -Cashla-Screeb	936	1.489 km^2 / 148.9ha	0.16%	48%	1 (Abhainn na nArd Doiriú)	Abhainn Bhoth Loiscthe / Galway Bay
					4 (An Sruthán Buí)	Abhainn Bhoth Loiscthe / Galway Bay

8.3.2.2. Watercourses

The EPA delineated watercourses relevant to this assessment are marked on Figure. 8.2 which shows the EIAR study boundary in relation to the channels.

Table 8.6 Watercourse Naming

Local Name	EPA Stream Name	Stream Order	EPA RWB Name	EPA RWB Code
Sruthan Chnocan Raithní	Knockaunranny	2	Knockaunranny Stream_010	IE_WE_30K020200
Upper Eochaire	[tributary of] Eochaire	1	Knockaunranny Stream_010	IE_WE_30K020200
Sruthan Bui	Cnoc Raithní	2	Owenboliska_010	IE_WE_31O010200
Abhainn na nArd Doiriú	Un-named	3	Owenboliska_010	IE_WE_31O010200
Leitir	Leitir	1	Owenboliska_010	IE_WE_31O010200

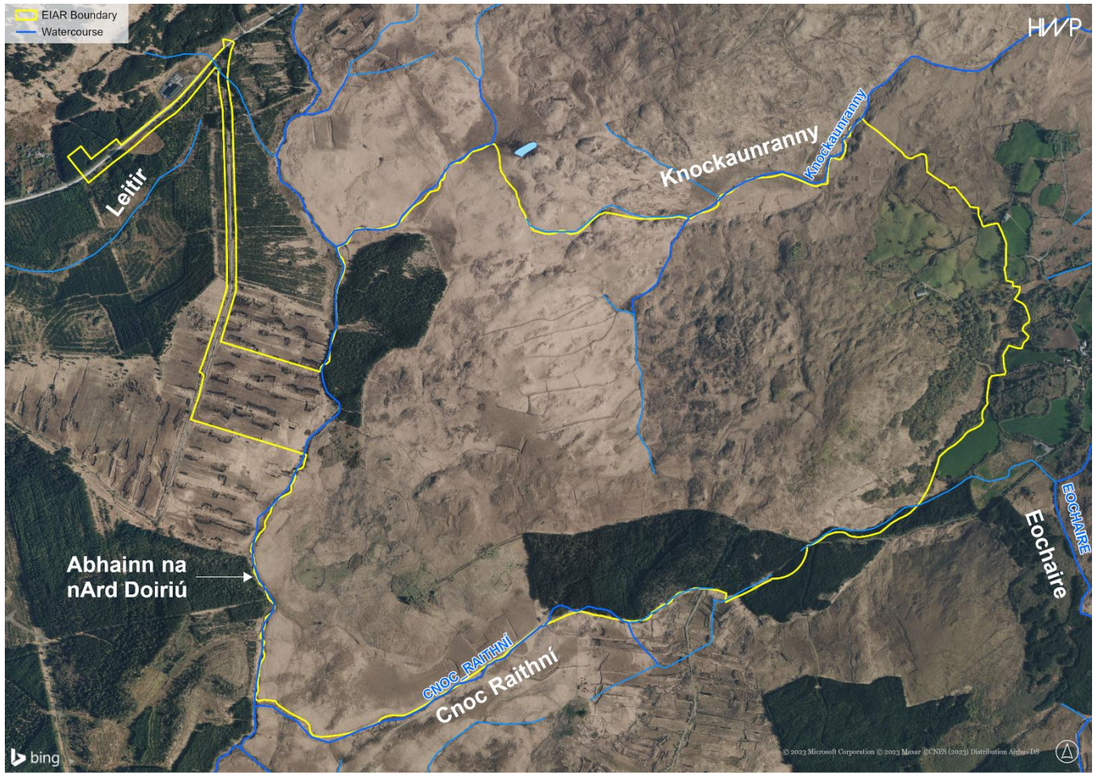

Figure 8.2 Map of watercourses in relation to the Proposed Development RLB

High precipitation rates, low permeability of the peat substrate, together with high water tables and high water saturation, results in a limited ground infiltration capacity during periods of heavy rainfall. Therefore, overland or surface water flow constitutes the dominant hydraulic pathway in this peatland environment.

Ballycuirke Lough Stream Sub-catchment - Watercourses

Upper Knockaunranny: The headwater channels of this stream are small 1st and 2nd order channel reaches within the proposed development site, forming narrow bog drains with mainly soft peaty detritus substrates. They are low quality channels, covered in heavy iron bacterial deposits with no salmonid spawning habitat and little or no nursery habitat potential. These upper channels are unsuitable for salmon, lamprey or freshwater pearl mussels. *Category E – Local Importance (lower value).*

Lower Knockaunranny Stream: Circa 1.7km downstream from the Proposed Development Red Line Boundary, the stream forms silty riffle-glide habitats comprising poor salmonid spawning potential, but fair nursery habitat for trout and brook lamprey. Another ~1 km downstream (at the N59) the stream size increases (after the confluence with Eochaire Stream) and comprises fair-to-good trout spawning and nursery habitat. The stream is unsuitable for salmon or freshwater pearl mussel, but silt deposits would be suitable for Brook lamprey (*Lampetra planeri*) nursery. *Category D – Local Importance (higher value).*

Upper Eochaire: One small headwater channel flows from near the permitted T1 eastwards to meet the Eochaire Stream. The upper headwater is a low-quality forest drain with soft substrates and no fisheries significance. The channel steepens moving downstream to form an eroding step-pool habitat with small boulder-cobble

substrates. The low gradient reach nearer the Eochaire main channel may have low density trout population (perhaps foraging up from the Eochaire), but is unsuitable for salmon, lamprey or freshwater pearl mussel. *Category E – Local Importance (lower value).*

Eochaire Stream: This is a tributary of Knockaunranny Stream that drains Lough Aderreen: a small, off-site upland lake to the east. The channel is ~4.0m in width as it nears the Knockaunranny confluence and comprises riffle-glide habitat over cobble and boulder, with native broadleaved scrub along much of the riparian zone. There is patchy trout spawning and good nursery habitats for trout. Brook lamprey could spawn in the channel, but there is no suitable lamprey nursery. Completely unsuitable for freshwater pearl mussel. *Category D – Local Importance (higher value).*

Owenboliska Sub-catchment Watercourses

Abhainn na nArd Doiriú: The main channel at the west of the Proposed Development site is ~4.0-5.0m wide, incised into deep peat and forming predominantly long, slow glides over soft, peaty substrates with heavy iron bacteria coating. Such habitat is unsuitable for salmonid spawning and nursery but may hold some older fish. A reach of ~200m near the proposed clear-span bridge crossing (part of the Permitted Development) is of slightly higher gradient with step-pool and run-glide habitat over large boulders, with small proportion of cobble and no gravels. Salmonid spawning cannot be ruled out in the reach but the habitat is very sub-optimal. If salmonids did manage to spawn, the nursery habitat is fair-to-good. Banks are generally vertical peat with heath vegetation. Forestry lines the channel in the upstream reaches adjacent the Proposed Development. The river flows southwards into Lough Ardderroo gradually improving near the inflow to the Lough, to form more natural riffle-glides over mixed stony substrates where salmonid spawning is limited, but nursery habitat is good. *Category D – Local Importance (higher value).*

Cnoc Raithní Stream: Small, 1st order, low-quality channel originating as a peat-lined drain within forestry near permitted T3. It flows sluggishly through open heath as a narrow bog drain (~50cm wide at most) with mainly peaty detritus substrates and some embedded muddy cobble. The channel intermittently broadens out through wet mire / swamp. There is no salmonid or lamprey spawning or habitat potential. *Category E – Local Importance (lower value).*

Leitir Stream: Small, 1st order, low-quality forestry drain that is piped under the access road which leads to the Ardderroo substation. The Leitir drain eventually outfalls to Lough Naweelan 3.2km downstream of this point on the ephemeral upper reach of this modified drain system. There is no salmonid or lamprey spawning or nursery habitat potential. *Category E – Local Importance (lower value).*

Lakes

There are no lakes of any significant size within the site. Some bog pools and swamp areas occur within the site and are associated with lowland blanket bog on the northern and southern peripheral lower slopes.

8.3.2.3. Water supply sources

Consultation with GCC indicated that approximately 7km southeast of the site is the Boliska Lough, which is the source of the Spiddal Water Supply. Lough Corrib lies approximately 11km east and downstream of the proposed site and supplies water for up to 70,000 consumers in County Galway.

8.3.2.4. Surface Water Quality.

The water quality assessment of surface waters within, adjacent to and downstream of the proposed development site are based on data collated from both physico-chemical and biological surveys.

Biological Water Quality

Table 8.7 lists EPA Q-value data for nearest long-term monitoring sites on the Knockaunranny Stream and Owenboliska River for the years 2003-2021.

Table 8.7 EPA Q-value Data 2003 – 2021

EPA River Station Code	EPA name	River Station	2003	2006	2009	2012	2015	2018	2021
30K020200	Knockaunranny	Bridge u/s Ross Lake	Q4-5	Q4	Q4	Q4	Q4	Q4	Q4
31O010100	Owenboliska	U/S Lough Boliska	Q4	~	~	~	~	~	Q4
31O010200	Owenboliska	Bridge in Spiddal	Q4-5	Q4	Q4-5	Q4-5	Q4-5	Q4-5	Q4

Knockaunranny: The single monitoring site in this stream was previously at 'high' status (Q4-5) but declined and remained at 'good' status (Q4) from 2006 to 2021 (most recent sampling). The stream attains good status and hence is currently compliant with WFD objectives.

Owenboliska: There are 2 no. relevant EPA monitoring locations in this catchment. The site upstream of Lough Boliska (RS31O010100) is located ~6.5km downstream of the Proposed Development and recently attained 'good' status (Q4), hence currently being compliant with WFD objectives. The site at the bridge in Spiddal is a further ~6.5km downstream, via Lough Boliska. Most recently the site recorded good status, a decline from mainly 'high status (Q4-5) for the previous 18 years.

Surface Water Hydrochemical Quality.

Field results

Spot-check hydrochemical analyses were carried out at 11 locations at the proposed development site. The parameters tested included temperature, pH, electrical conductivity, total dissolved solids and dissolved oxygen. Table 8.8 presents results of spot-check survey.

All field pH levels are within the pH boundaries according to both the European Communities (Quality of Surface Water intended for drinking) Regulations, 1989, and for the European Communities (Quality of Salmonid Waters) Regulations 1988, and also for Surface Water Regulations 2009. All electrical conductivity values taken were found to be below the 1000 uS/cm limit outlined in the 1989 European Communities (Quality of Surface Water intended for the abstraction of drinking water) Regulations. All value for dissolved oxygen Percentages surpass the 60% value of dissolved oxygen necessary for the water to consign to the A1 quality of water. See Figure 8.3 for water sampling location map.

Table 8.8 Field spot-check sampling results

Sample station number	Easting	Northing	pH	Total Dissolved Solids	Electrical Conductivity (uS/cm)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/l)	Temp (°C)
1	113341	232057	7.9	0.047	20.4	94.3	11.14	7.9
2	114605	235434	8.27	0.06	15.95	13.57	4.41	8.27
3	114672	234225	8.02	0.051	18.76	11.32	4.14	8.02
4	114520	233449	8.11	0.045	19.09	176.31	21.6	8.11
6 (a)	112830	233449	7.94	0.038	25.59	104.1	13.05	7.94
6	117920	235095	7.51	0.05	19.52	154.6	8.25	7.51
7	117269	234220	7.3	0.049	20.27	176.31	12.6	7.3
8	116304	233649	7.82	0.049	19.56	123.7	14.16	7.82
8 (a)	116304	233649	8.14	0.068	14.18	103.9	12.13	8.14
9	115928	233502	8.06	0.053	18.31	94.2	11.02	8.06
10	115391	233369	7.87	0.057	17.01	85.4	10.12	7.87
11	115731	234127	8.15	0.036	26.3	194.4	20.75	8.15

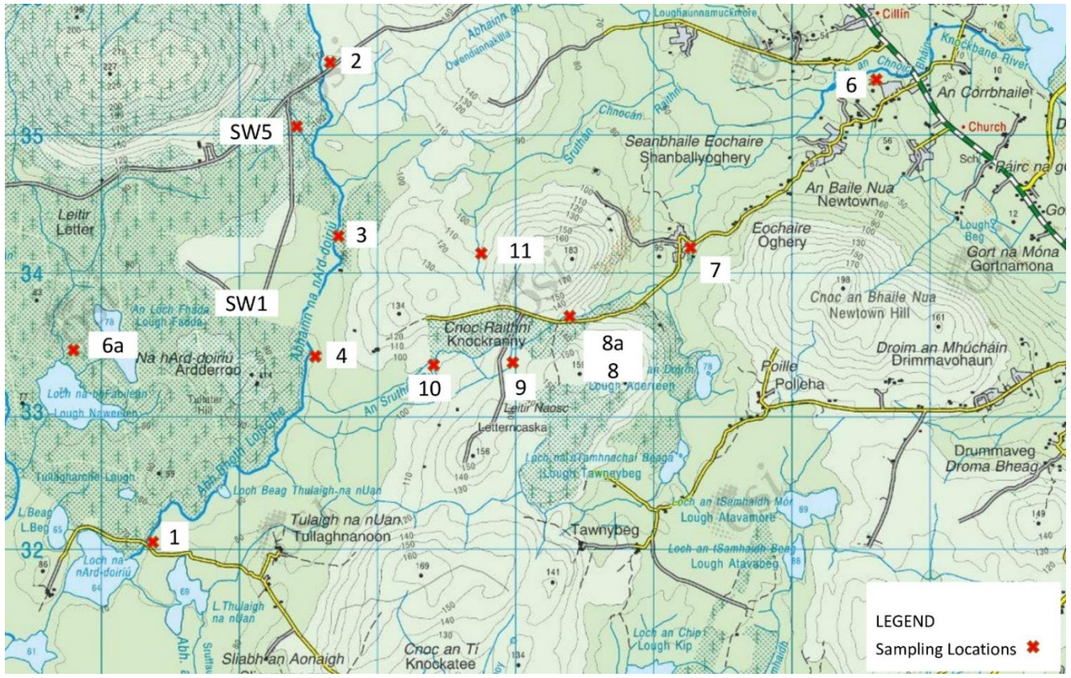

Figure 8.3 Water Sampling Locations

Laboratory Results

Two sets of samples (2013 and 2023) were collected and sent to an accredited laboratory for testing. The analytical results are presented in Tables 8.9.and 8.10.

Laboratory results were compared with thresholds set in the Surface Water Regulations (2019) and show that most of the samples meet the "High" status and show no evidence of pollution and that all samples meet the threshold for "Good" status.

Table 8.9 Water Quality Analysis (2013)

Sample station number	pH	Suspended solids (mg/l)	Nitrate (mg/l)-N	Nitrite (mg/l)-N	MRP (mg/l)-PO4	Total Phosphorus (mg/l)- P	Aluminium (mg/l)	Sulphate (mg/l)
1	5.1	2	<0.25	<0.005	<0.01	<0.04	0.04	2.36
2	4.3	<2	<0.25	<0.005	<0.01	<0.04	0.10	2.47
3	4.6	<2	<0.25	<0.005	<0.01	<0.04	0.07	2.35
4	4.7	<2	<0.25	<0.005	<0.01	<0.04	0.06	2.28
6 (a)	5.8	<2	<0.25	<0.005	<0.01	<0.04	<0.01	2.62
6	6.6	<2	<0.25	<0.005	<0.01	<0.04	0.02	2.84
7	6.6	<2	<0.25	<0.005	<0.01	<0.04	0.03	2.31
8	4.6	<2	<0.25	<0.005	<0.01	<0.04	0.02	1.97
8 (a)	4.1	9	<0.25	<0.005	<0.01	0.04	0.12	1.91
9	5.3	3	<0.25	<0.005	<0.01	0.06	0.03	1.79
10	5.1	3	<0.25	<0.005	<0.01	<0.04	0.04	2.54
11	5.7	<2	<0.25	<0.005	<0.01	<0.04	<0.01	2.27

Table 8.10 Water Quality Analysis - February 2023

Sample station		1	2	3	4	6	6 (a)	7
BOD	(mg/l)	<1	1	1	1	<1	<1	<1
Suspended solids	(mg/l)	<2	<2	<2	<2	<2	<2	2
COD	(mg/l)	33	42	32	34	11	44	16
pH	pH Units	6.3	5.5	6	6.1	6.3	6.5	6.9
Conductivity	uS/cm	86.2	90	87.4	86.7	68.7	122	108
Nitrate	(mg/l)-N	0.14	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrite	(mg/l)-N	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Total Phosphorus	(mg/l)-P	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ammonia	(mg/l)-N	0.043	0.071	0.103	0.053	<0.005	0.006	<0.005
Aluminium (total)	(mg/l)	120	195	163	146	39	181	98
MRP as PO4	(mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	0.011	<0.01
Dissolved O2@lab	(mg/l)	9.03@lab	8.95@lab	9.03@lab	9.02@lab	9.05@lab	8.99@lab	8.96@lab
Sample station		8	8 (a)	9	10	11	SW3	SW5
BOD	(mg/l)	<1	<1	<1	<1	<1	<1	<1
Suspended solids	(mg/l)	<2	<2	<2	<2	<2	<2	<2
COD	(mg/l)	27	25	65	62	50	63	74
pH	pH Units	6.3	6.3	5.6	5.4	5.8	7.3	4.9
Conductivity	uS/cm	101	101	99.9	104	66.6	173	86.7
Nitrate	(mg/l)-N	<0.1	<0.1	<0.1	<0.1	<0.1	0.285	<0.1
Nitrite	(mg/l)-N	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Total Phosphorus	(mg/l)-P	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ammonia	(mg/l)-N	0.022	0.046	0.027	0.031	0.018	0.014	0.022
Aluminium (total)	(mg/l)	96	93	94	116	45	219	308
MRP as PO4	(mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.028
Dissolved O2	(mg/l)	8.94@lab	8.96@lab	8.97@lab	9.00@lab	8.98@lab	8.96@lab	9.02@lab

8.3.2.5. Surface Water Dependent Ecosystems

The nearest hydrologically connected designations are:

- Ross Lake SAC and pNHA (Site code 001312) located ~4km downstream, east of the Proposed Development RLB
- Connemara Bog Complex SAC and pNHA (Site code 002034) located ~200m south of the Proposed Development RLB

Impacts on aquatic ecosystems and aquatic biodiversity are assessed in Chapter 9 – Biodiversity, of this EIAR.

8.3.3. Hydrogeology

The hydrogeological environment comprises groundwater and the underlying bedrock which contains and transmits water as part of the hydrological cycle. Groundwater is an important water source as it provides base-flow to rivers and surface water bodies and is a natural resource for human activities. The following section describes the existing hydrogeological environment in terms of:

- Groundwater body;
- Aquifer classification;
- Vulnerability assessment;
- Abstraction; and
- Water quality in the context of the proposed development site.

8.3.3.1. Groundwater body

The site lies within two groundwater bodies (GWB), namely the Maam Clonbur GWB, which drains the site into the Lough Corrib catchment, and the Spiddal GWB, which drains the site into the Owenaboliska-Cashla-Screeb catchment.

The land surface of the Maam Clonbur GWB is characterised by steep slopes and mountainous terrain, flattening in an easterly direction toward the shores of Lough Mask and Lough Corrib. It measures 524km2 and in the context of the proposed development site is associated with the Knockbane River that drains into Ross Lake. The GWB comprises mostly low transmissivity rocks and water levels are approximately 0-8m below ground level. Groundwater flow is likely to be concentrated in fractured and weathered zones and in fault zones and most groundwater flow is likely to be in the uppermost part of the aquifer. Diffuse recharge to the GWB occurs via rainfall percolating through the subsoil and via outcrops. Due to the low permeability of much of the peat subsoil and the aquifers in the GWB, a high proportion of the available recharge will discharge rapidly to the streams and lakes in the GWB. Steep slopes in the mountainous areas of the GWB also promote surface runoff. Stream density is approximately 1.5 km/km2 in the GWB, which indicates the high proportion of surface runoff, or main hydraulic pathway. Small springs and seeps are expected to occur at the stream heads and along their course. Due to the poor productivity of the aquifers in this GWB it is unlikely that any major groundwater and surface water interactions occur and base flow to rivers and streams is likely to be relatively low.

The Spiddal GWB is bounded on the south by the coastline and to the north by surface water divides and the Precambrian Marbles present on a line from Clifden Recess Maam Cross. The GWB comprises mostly granites overlain by peats with some rock at surface and the land surface is characterised by steep slopes and mountainous terrain flattening towards the coastline. It measures 774km2 and in the context of the proposed development site is associated with the Abhainn na nArd Doiriú River. Similar to the Maam Clonbur GWB, the Spiddal GWB comprises mostly low transmissivity rocks with water likely to be concentrated in fractured and weathered zones and in fault zones. Water levels are approximately 0-6m below ground level and follow topography with overall flow direction to the south. Stream density is > 1 km/km2 in the GWB, which indicates the high proportion of surface runoff. Shallow groundwater is likely to discharge to streams and lakes, but the limited bedrock transmissivity means that the baseflow component of the total streamflow will be low.

8.3.3.2. Aquifer classification

An aquifer is defined as a geological formation that is capable of yielding quantities of water. Geological strata are categorised for hydrogeological purposes as Major Aquifers (Regionally Important) Aquifers, Minor Aquifers (Locally Important) Aquifers or Unproductive Rocks (Poor Aquifers / Aquitards). The site is underlain by Porphyritic-Megacrystic Granite (Galway Granite) which is classified as a Pl (Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones). The Galway Granites is a poor yielding low transmissivity geological unit and is therefore considered as Unproductive Rock. These aquifers have little throughput and are generally only capable of giving low yields to wells.

8.3.3.3. Vulnerability

Aquifer vulnerability provides an indication of the ease with which potential contaminants can migrate downwards from the surface into the underlying aquifer. The GSI classification of the vulnerability of an aquifer is based on the thickness and the permeability of overburden. The greater the thickness and permeability, the greater the protection to the groundwater in the underlying aquifer. The classification system is shown in Table 8.11. Vulnerability of groundwater within most of the site is considered extreme (E). In some scattered locations vulnerability is classified as extreme vulnerability with rock near surface (E).

Table 8.11 Vulnerability Mapping Guidelines

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

Notes: (1) N/A = not applicable.
(2) Precise permeability values cannot be given at present.
(3) Release point of contaminants is assumed to be 1-2 m below ground surface.

The GSI vulnerability classification for the area is shown in Figure 8.4

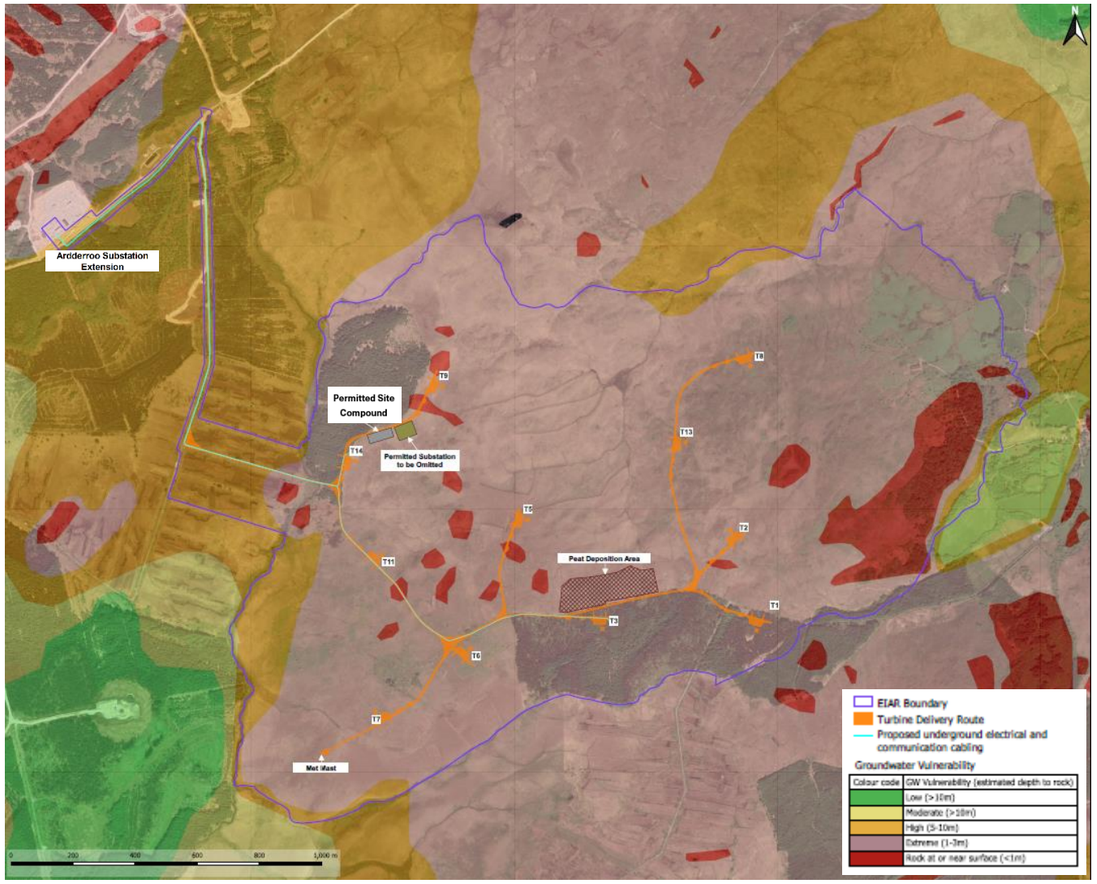

Figure 8.4 Groundwater vulnerability mapping at the Knockranny Wind Farm site location

8.3.3.4. Karst

The site is underlain by Galway Granite and consequently there are no karst features in the vicinity.

8.3.3.5. Groundwater Abstractions

The nearest well recorded on the GSI well database is at Shanballyoghery for domestic use approximately 1.5km east of the site. The next closest recorded well is located adjacent to the N59 and is over 2km from the site.

There are no known large springs or large public water supply abstractions within 5 km of the development site.

8.3.3.6. Groundwater Quality

Data available for granitic rocks across the country indicate that alkalinities range from 43-298 mg/l ($CaCO_3$) with a median of 184 mg/l ($CaCO_3$); total hardness ranges from 103-304 mg/l with a median 178 mg/l and conductivity ranges from 317- 1017 µS/cm with a median of 461µS/cm (GSI, 2004a). Data available for granitic rocks across the country that are not overlain by sand/gravel or limestone till indicate that alkalinities range from

43-135 mg/l (CaCO3) with a median of 122 mg/l (CaCO3), total hardness ranges from 103-201 mg/l with a median 136 mg/l and conductivity ranges from 317-462 µS/cm with a median of 440 µS/cm (GSI, 2004b).

Groundwater Bodies (GWB) have been designated for the purpose of the Water Framework Directive (WFD) (Directive 2000/60/EC). GWBs are subdivisions of large geographical areas of aquifers that allow more effective management to protect the groundwater and linked surface water or groundwater dependent features.

The site lies within the Maam Clonbur GWB and Spiddal GWBs which are comprised primarily of rocks that have a low permeability/.

The overall GWB Water Framework Directive (WFD) status (2016-2021) for both these is "Good". The groundwater risk status for the region is 'not at risk'.

8.3.4. Water balance

Water balance describes the flow of water into and out of the site. High precipitation rates combined with the low permeability of the soil and subsoil means that during periods of rainfall there is limited capacity for rainwater to infiltrate the ground. The majority of rainwater received is therefore rejected and runs off as overland flow. Surface water runoff either as overland flow or into the site drainage network is the dominant hydraulic pathway within the environs of the Proposed Development site.

Recharge data was sourced from the GSI (www.gsi.ie) provided the following.

Annual average effective rainfall. 1062 mm

Annual recharge. 100 mm

Annual Runoff will be 962 mm per year which js high, reflecting the low recharge

8.3.5. Flood Risk.

OPW Indicative Flood Maps (www.floodmaps.ie) and CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie)were inspected to identify areas of historical flooding. The nearest flood event to the site in the Lough Corrib catchment occurred south of Moycullen village, which is located 5km to the southeast, while the nearest flood event in the Owenaboliska- Cashla-Screeb catchment occurred north of Boliska Lough. No flood events have been recorded within or in the vicinity of the site or the local access route from Doon.

8.4. Likely Significant Impacts

This section addresses the potential impacts on the environment from activities during construction and operation of the proposed development. The potential impacts may comprise direct and indirect impacts on the groundwater and surface water environments.

The conventional source-pathway-target model was applied to assess potential impacts on hydrological and hydrogeological environmental receptors as a result of the proposed development.

With the exception of the river crossing along the permitted wind farm access road, hydrological buffers of 50m on streams and rivers within and adjacent to the site were avoided during the design of the wind farm infrastructure. The underground electrical and communications cabling route will traverse some existing piped culvert and watercourse crossings. This includes the crossing of an unnamed minor watercourse at two locations. One of these crossings is a trench in an existing road which will not impact on culvert structure or flow. The second watercourse crossing will be in an off-road access track whereby it is proposed to extend the existing pipe under the road with the cabling crossing over it. The current proposals for all construction activities and operational infrastructure were reviewed to identify activities likely to impact upon identified water bodies including water courses within, beneath and remote from the site.

Following the identification of sensitive water receptors and potential sources of water impacts, the extent and severity of potential construction impacts, proposed control measures were included in the project design.

8.4.1. Do Nothing Scenario

In the absence of the proposed development, the implementation of the Permitted Development will proceed and there will be no change in the predicted impacts on the hydrological and hydrogeological environments.

8.4.2. Assessment of Effects During Construction

8.4.2.1. Construction Activities that interact with the water environment.

Planning permission is being sought for modifications to the Permitted Development.

These modifications comprise;

- Alterations to the Permitted Development comprising the increase of the tip height from a maximum of 140.5m to 150m;
- The omission of the previously approved on-site substation and associated underground cabling;
- The development also includes the connection to the electricity grid including the laying of underground cables and connection to the Ardderroo substation. Electrical cables will extend from the permitted T3 and T14 wind turbines. Trenching to be undertaken within a forestry road (road to be widened), windfarm site and off-road service track to the south of the Ardderro substation road. The grid connection requires the extension of infrastructure to the Ardderroo substation comprising IPP control building, (c.75 m^2) additional transformer and associated electrical equipment. See Section 2.3.6
- Amendments to the existing roadside artificial drainage measures;
- All ancillary works above and below ground necessary to facilitate the development.

A detailed description of the Proposed Development is outlined and presented in Chapter 2 of this EIAR.

Potential sources of water quality and water flow impacts arising from the construction of the Proposed Development will be similar to construction related activities for the Permitted Development. These activities and their interactions with the receiving environment and associated potential sources of pollution are identified and examined in the following sections.

There will be no abstraction from surface water or groundwater. The only discharge to surface water will be routine construction runoff which may contain silt suspended solids. The only introduction of contamination to the surface water and groundwater environment would be as a result of accidental spillages and/ or poor construction practices.

Runoff and erosion from site surfaces, drainage channels and earthworks areas

Suspended solids can be derived from the physical disturbance of the ground during the course of excavation as a consequence of accelerated rates of runoff, or loosened fine particulate matter lifted from the surface of spoil heaps; from excavated surfaces; from access roadside slopes prior to the re-establishment of vegetation

coverage; or the surface of access roads or hardstands if not correctly compacted. Incorrect site management of excavations could lead to loss of suspended solids to surface waters. Excavation of peat could lead to an increase in suspended solids in the surface water run-off from exposed peat or from the underlying mineral soils.

Runoff from peat storage areas

Incorrect management of the excavated peat could lead to loss of suspended solids to surface waters. Incorrect management of the drainage of peat storage areas could also lead to a loss of suspended solids to surface waters.

Concrete (used for the construction of foundations)

While this has been assessed in the EIS for the development. There is a potential risk of spillage and run off from additional trucks delivering concrete to site during the placing of concrete for the redesigned foundations, and also in the washing out of chutes. The spillage of cement material into a watercourse would significantly impact on the pH of the water and thus impact on water quality. Similarly, the infiltration of such runoff could impact on local groundwater quality.

Water contamination from accidental spillages of hazardous material

Contamination of water may potentially occur, particularly during the construction phase, in the form of fuel oil leakage or spillage from construction equipment and vehicles. Inappropriate storage or application of lubricants; or the careless usage of construction chemicals. Incorrect management of accidental spillages on site could lead to the release of hazardous chemicals to surface and ground waters.

Alterations/ Interruptions to the existing site drainage

The construction of new infrastructure has the potential to interrupt existing overland flow. The provision of the cable service track will require some alterations to the existing artificial drainage south of the existing road serving Arderroo substation. This has been proactively considered as part of the design process and will include the relocation of some drainage measures to the south of the proposed track. Piped channels under the track will continue to convey runoff to the relocated drainage measures, with the build-up of the service track allowing surface water to filter beneath and prevent any ponding occurring beneath the roads.

Over-the-edge drainage measures will apply in the case of the widening of the existing road for the electrical and communications cabling to the south, supplemented by silt fencing on the lower side to treat any 'dirty runoff' before discharge to ground.

Grid Connection Route

The Proposed Development will extend the underground electrical and communications cabling west to Ardderroo substation. This includes one additional watercourse crossing of a minor stream which is currently piped beneath the substation road that drains to the south. This piped culvert extension will be installed during a low flow period. The instream works area will be made dry using a temporary pipe extension that carries drain flow over the entire works area. The permanent extension will be laid at the same gradient as the existing culvert and shall be embedded at the downstream end a minimum of 30cm with appropriate scour protection, if necessary, in the form of cobble/gravel substates. The second crossing will comprise a shallow trench in an existing road which will not impact on the culvert structure and as such, there will be no in-stream works. The local topography has been altered by existing forestry tracks and plantings. Both crossings occur on a small 1st order tributary of the Abhainn na nArd Doiriú.

This approach avoids any direct impact on local drainage. There is no significant source/hazard associated with these operations and consequently it will not have any effect on the hydrological or hydrogeological environments.

8.4.2.2. Evaluation of impacts

Based on the assessment of potential sources of impact from the construction of the Proposed Development, the likely significant impacts identified are:

- Impacts on surface water quality;
- Impacts on surface water flow; and
- Impacts on groundwater quality;
- Impacts on groundwater flow regime;

Surface Water Quality Impacts

The extent of water quality impacts associated with the works will depend upon the construction method chosen, pollution controls and preventative measures, ground conditions and the distance from water sensitive receivers.

Excavation activities over and above those associated with the Permitted Development will be associated with the alterations to the underground cabling route and the slightly larger foundations. The activities will occur mainly within conifer forest, cutover bog and wet heath. Therefore, the key pollution risks would be mobilization of suspended solids, particularly from peaty soils and nutrient release from transported or suspended sediments.

The assessment of the existing water environment has identified the following:

1. Water receptors within the EIAR study area comprise ephemeral streams / drains, which discharge into streams and rivers within and adjacent to the site boundary.
2. Site infrastructure footprint area is drained by a number of sub-catchments into receiving rivers and streams as follows):

The main surface water quality concern is the potential for pollution of water that interacts with the proposed infrastructure (the source) and its consequent transport via overland flow and ephemeral streams / drains (the pathway) to sensitive watercourses such as the Abhainn na nArd-doiriu, Sruthan Bui Sruthan Chnocan Raithni and Lough Adereen stream (the receptors)

Overall, it is not envisaged that there is high risk to receiving rivers and streams or WFD Protected Areas. There are no potential discharges to surface waters apart from site runoff or the unlikely event of a minor fuel or chemical spill. As the potential water quality impact is expected to be locally confined to the immediate vicinity of the Proposed Development area, direct impact upon these sensitive receptors is not anticipated.

Impact of silt laden runoff: In the absence of mitigation and control measures is assessed to be *Slight/Moderate adverse* and *temporary* in duration.

Impact of accidental chemical/fuel spill: In the absence of mitigation and control measures is assessed to be temporary *Slight/Moderate Adverse* and *Temporary* in duration with a *Possible* likelihood of occurrence.

Surface water flow Impacts

Increase in runoff contributing to flooding. The Proposed Development site is located in an area where the runoff component of annual effective rainfall is high (approximately 90%). There will be no discernible increase in the rate of runoff from heavy rainfall events during the construction stage.

The impact of the proposed development on flooding in the absence of mitigation is therefore considered to be *Imperceptible Adverse long- term* impact.

Groundwater Quality and Aquifer Resource

Fuel and chemical spills are a potential source of groundwater pollution if uncontrolled. Storage of large volumes of fuel and other contaminants are not anticipated. In the event of a spill the nearest recorded domestic dwelling is greater than 1 km from the site and if it has a groundwater supply from a well the impact on its water quality in the absence of mitigation will be *imperceptible adverse* and *temporary*.

There is very limited interaction between construction activity and the groundwater environment. The slight Increase in the development footprint resulting from the Proposed Development will constitute only a tiny fraction of the recharge area to the aquifer and the reduction in the already low recharge will have no discernible impact on the groundwater resource available.

The impact on the aquifer beneath the site will be *Imperceptible.*

8.4.3. Assessment of Effects During Operation

8.4.3.1. Operational effects that interact with the water environment

The operation of the proposed development will not involve any point source discharges and there will be no other material releases that would cause adverse impacts on surface waters or groundwater. Wind turbines, and their associated equipment, use lubricating and insulating oils in a closed system. An integrated waste holding tank exists for wastewater collection at the Ardderroo substation. The potential sources of impact on the hydrological and hydrogeological environments during the operational phase include:

- Operational drainage; and
- Increased surface water runoff.

Increased surface water flow

The revised turbine bases create additional areas of low permeability from which increased surface water runoff can occur. The additional foundation footprint will be reinstated with landscaping/ peat to avoid any additional impact of the Permitted Development.

Similarly, the additional surfacing of the cable route track is insignificant in comparison to the overall catchment runoff area.

However, the existing permeability is already very low so the increased rate of runoff is extremely low.

Change in Recharge Area

As stated above the increase in hardstanding area will constitute only a tiny fraction of the recharge area to the aquifer and the reduction in the already low recharge will have no discernible impact on the groundwater resource available.

8.4.3.2. Evaluation of impact

Based on the assessment of potential sources of impact from the operation of the Proposed Development, the likely significant impacts identified are:

- Impacts on Surface water quality;
- Impacts on Surface water flow; and
- Impacts on Groundwater quality and Aquifer resources

Impacts on Water Quality

There is a low risk of pollution during the early operation phase of the Project that is associated with drainage runoff and attenuation of suspended solids. Impacts to water quality are expected to be *Slight Adverse* and *temporary* in duration. The Proposed Development will not significantly alter the operational effects of the Permitted Development.

Impacts on Surface Water Flow

The slight increase in impermeable surfaces that will be created constitute a change to a tiny fraction of the runoff catchment. The increased surface water flow or potential for hydraulic loading is considered to be *Adverse, Slight and long-term in duration.*

Impacts on Groundwater Quality and Aquifer Resources

There is no change in the site operation of the Permitted Development. The runoff will comprise typical rainfall runoff of a similar quality to that which runs off at present.

A *neutral* impact on groundwater quality is predicted.

Decommissioning Impacts

Decommissioning activities will take place in a similar fashion to the construction phase. Potential effects will be similar to the construction phase but on a reduced scale. Therefore, the residual decommissioning impacts are considered to be *Imperceptioble/Slight Adverse*.

8.5. Mitigation Measures and Monitoring

Mitigation has been embedded in the design considerations (see below), and the potential impact of the Proposed Project as designed has been assessed. Additional mitigation which will be employed to reduce residual impacts is described below.

The construction contracts will require that the contractor at construction stage produce a contract specific Construction Environmental Management Plan (CEMP). The specific measures identified as minimum requirements to be included in a CEMP to ensure any impacts are limited, are summarised in the following subsections.

8.5.1. Mitigation by Design and Avoidance

The underground electrical and communications cabling route to the Ardderroo substation crosses a small, culverted 1st order tributary of the Abhainn na nArd Doiriú at two locations. In one case, the crossing has been designed to ensure that the cabling passes over culvert within the makeup of the existing road. There will be no direct impact on the stream. In the second case, the culvert will be extended with the cabling passing over it in access track.

A level spreader will be constructed at the end of each interceptor drain to convert concentrated flows in the drain, into diffuse sheet flow on areas of vegetated ground. The levels spreaders will be located downgradient of any works areas in locations where they are not likely to contribute further to water ingress to construction areas of the site.

The water carried in interceptor drains will not have come in contact with works areas of the site, and therefore should be free of silt and sediment. The level spreaders will distribute clean drainage water onto vegetated areas where the water will not be re-concentrated into a flow channel immediately below the point of discharge. The discharge point will be on level or only very gently sloping ground rather than on a steep slope so as to prevent erosion. Figure 4-2 shows an illustrative example of a level spreader.

These works will be undertaken in accordance with a detailed method statement which mitigates the potential for any environmental effects (Section 8.4).

8.5.2. Construction Environmental Management Plan (CEMP).

A CEMP has been prepared and is enclosed with planning application. The CEMP will ensure that any impacts are limited, and mitigation measures are summarised in the following subsections. An Environmental Clerk of Works (ECoW) with appropriate experience and expertise will be employed for the duration of the construction phase to ensure that all the environmental mitigation measures outlined in relation to the environment are implemented. This ECoW will be awarded a level of authority and will be allowed to stop construction activity if there is potential for adverse environmental effects to occur.

8.5.3. Mitigation – Hydrology Construction Phase

To prevent or reduce the amount of sediment or other polluting substances being released into watercourses, the following measures will be incorporated into the Construction Environmental Management Plan for the Proposed Project. In addition to the mitigation measures identified in relation to the Permitted Development there will be a need for the following additional measures:

- All temporary construction compounds, storage areas will be located >50 m from any water course.
- Immediate removal/disposal of surplus material off-site will be implemented.
- Drainage within soil bunds will be provided to reduce the influence upon the surface runoff pathways of flood water.
- Direct discharge of surface water from any temporary impervious area to the nearby watercourse without proper attenuation will be avoided;
- Construction will follow current standard and regulated practices to minimise sediment transport. Perimeter erosion and sediment control measures will be installed around the entire wind farm development footprint. This will include upslope clean water interception channels, down-slope dirty water collection channels, and construction of temporary sediment traps where required.
- Pollution control measures for concrete pouring to include effective containment will be implemented. Dedicated concrete cute washout area to be provided.
- During the construction phase, an integrated waste holding tank will be used on site for toilet facilities. This will be maintained by the service contractor on a regular basis and will be removed from the site on completion of the construction phase.
- Temporary attenuation ponds will be provided if the stream to which surface water from the construction area is discharged has limited capacity.
- The surface water runoff at the construction sites will be managed to prevent flow of silt-laden surface water flowing into adjoining surface watercourses. To achieve this, the appointed contractor(s) must comply with the CIRIA publication *Control of water pollution from linear construction projects. Technical Guidance (C648)* (CIRIA 2006).
- Construction will follow current standard and regulated practices to minimise sediment transport. Perimeter erosion and sediment control measures will be installed around the entire wind farm development footprint. This will include upslope clean water interception channels, down-slope dirty water collection channels, and construction of temporary sediment traps where required.
- All works in or adjacent to watercourses will comply with EPA, Inland Fisheries Ireland and OPW requirements.
- All tree felling will be undertaken using Forest Service good working practices to reduce the risk of entrainment of suspended solids and nutrient release, inclusive of hand felling, use of prescribed aquatic buffer zones, timber stacking outside buffer zones and the undertaking of works in periods of no or low rainfall.
- A water quality monitoring programme will set up prior to construction works and implemented to the agreement of Inland Fisheries Ireland, to include laboratory analysis, water quality monitoring instrumentation and visual inspections.
- On-site fuel storage and refuelling of plant and vehicles will be undertaken on impermeable and bunded areas and away from any rivers or other watercourses. Adequate means to absorb or contain any spillages are available at all times.
- The appointed contractor(s) will inspect and monitor the water quality of surface waters near any works, particularly in relation to increased silt levels. This monitoring process will form part of the Environmental Management Plan for the Construction Phase.

8.5.4. Mitigation – Hydrology Operational Phase

To prevent or reduce impacts on watercourses, Wastewater management during the operational phase will be facilitated by an existing holding tank at the Ardderroo Substation, the tank will be maintained by a licenced waste contractor that will be regularly empty it to a licensed wastewater treatment plant.

The additional foundation footprint will be reinstated with landscaping/ peat to the hardstanding generated by the Permitted Development.

Following on from the establishment of the water quality monitoring programme for the construction phase, regular water quality audits should be undertaken for the first 6 months of the operational development.

8.5.5. Mitigation – Hydrogeology Construction Phase

The only mitigation is adherence to best practice operating procedures related to sediment and erosion controls as specified above and detailed in the CEMP.

8.5.6. Mitigation – Hydrogeology Operational Phase

The only mitigation is adherence to best practice operating procedures including maintenance of drainage will be required during the operational phase as detailed in the CEMP.

8.6. Residual Effects

It is considered that the proposed Project design together with mitigation measures will ensure that no significant impact occurs to adversely affect surface water quality, surface water flows or groundwater resources. The overall impact on the hydrogeological and hydrological environments will be *imperceptible/slight adverse*.

8.7. Decommissioning Impacts

Decommissioning activities will take place in a similar fashion to the construction phase. Potential effects will be similar to the construction phase but on a reduced scale. Therefore, as the residual decommissioning impacts are considered to be *Imperceptible/Slight Adverse*.

8.8. Cumulative Effects

A cumulative impact arises from incremental changes caused by other past, present or reasonably foreseeable actions together with the Proposed Development.

Forestry, farming and peat cutting operations and other developments in the area have the potential to have an adverse effect on water quality together with the Proposed Development. Uggool, Cloosh and Letterpeck wind farms along with certain turbines within Knockalough and Leitir Gungaid wind farms occur within the Owenaboliska catchment. Turbines 1, 3, 6, 7, 9, 11 and 14 also drain into this catchment.

The list of projects that were considered for cumulative effects are listed in Section 1.10 of this EIAR (Chapter 1 Introduction).

The construction phase of the Proposed Development has the potential to contribute to cumulative impacts on downstream surface water bodies, the biggest risk is during as this is the phase when earthworks and excavations will be undertaken at the sites. The nearest development to be assessed in terms of cumulative impact is the Ardderroo Windfarm. which is presently under construction and should be substantially complete by the time construction commences on Proposed Development.

No significant cumulative hydrological or hydrogeological impacts are anticipated.

Other activities in the area of the Proposed Development include felling operations, which include a Coillte felling programme in operation in the area comprising a total area of forestry to be felled over the 9-year period from 2019-2027 of 697.82 hectares, 456.05 hectares of which has already been felled (as at February 2023, ref EPA web mapper – gis.epa.ie/EPAMaps and Forestry Licence Viewer – forestry-maps.apps.rhos.agriculture.gov.ie); Coillte also propose to fell an additional 13.8 hectares of forestry within the Ardderroo Wind Farm boundary as part of a bog restoration plan, subject to licensing. Felling operations are subject to Appropriate Assessment and are required to be undertaken in accordance with Standards for Felling and Reforestation (DAFM, 2019). No potential for significant cumulative impacts with these projects has been identified.

8.9. Difficulties Encountered in Compiling Information

No difficulties were encountered in compiling the information contained in this assessment.

8.10. References

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CNOC RAITHNÍ (KNOCKRANNY) WIND FARM

CHAPTER 9

Biodiversity

VOLUME II EIAR

CHAPTER 9 - Biodiversity

Contents

Chapter 9

9. BIODIVERSITY

9.1. Introduction

This chapter provides the Ecological Impact Assessment in relation to the Proposed Development.

This Ecological Impact Assessment outlines the biodiversity (floral and faunal features, excluding avifauna) of the receiving environment within the planning application area and within a wider Zone of Influence (ZoI) in the vicinity of the Proposed Development site. It comprises information as required by Annex IV to the EIA Directive to be contained in an EIA Report (EIAR), in respect of flora and fauna.

The aims of this ecological impact assessment are to:

- Review the existing baseline ecological data for the Proposed Development Site;
- Further add to baseline information by undertaking ecological field surveys of the receiving environment at the Site;
- Identify flora and fauna present within the footprint of all elements of the Project so as to identify the receiving environment;
- Determine the ecological value of the identified ecological features;
- Identify, describe and assess the likely significant effects of the Proposed Development on biodiversity (flora and fauna);
- Propose effective mitigation measures to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on biodiversity; and
- Identify any residual effects predicted to arise after mitigation.

A full description of the Proposed Development is provided in Chapter 2 of this EIAR.

9.2. Assessment Methodology

9.2.1. Guidelines

The assessment had regard to the following guidelines:

- CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester;
- DoEHLG (2010) Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities. Department of the Environment, Heritage and Local Government;
- European Communities (2000) Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC, Office for Official Publications of the European Communities, Luxembourg. European Commission;
- EC (2021) European Commission Notice Brussels C (2021) 6913 final 'Assessment of plans and projects in relation to Natura 2000 sites - Methodological guidance on Article 6(3) and (4) of the Habitats Directive 92/43/EEC;
- EC (2007) Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC – Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the commission. European Commission;
- EC (2013) Interpretation Manual of European Union Habitats. Version EUR 28. European Commission;
- EPA (2022) Guidelines on the information to be contained in Environmental Impact Assessment Reports. Draft. Environmental Protection Agency;
- Fossitt, J., 2000. A Guide to Habitats in Ireland. The Heritage Council, Kilkenny;
- HA (2001) DMRB Volume 10 Section 4 Part 4 - Ha 81/99 - Nature Conservation Advice In Relation To Otters. The Highways Agency;
- IFI (2016) Guidelines on protection of fisheries during construction works in and adjacent to waters. Inland Fisheries Ireland;
- National Parks and Wildlife Service (NPWS) (2019) The Status of EU Protected Habitats and Species in Ireland. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland;
- NRA (2008) Environmental Impact Assessment of National Road Schemes – A Practical Guide Rev. 1. National Roads Authority;
- NRA (2009) Guidelines for the Assessment of Ecological Impacts of National Road Schemes Rev. 2. National Roads Authority;
- NRA (2008) NRA Guidelines on Ecological Surveying Techniques for Protected Flora and Fauna on National Road Schemes. National Roads Authority;
- NRA Various Environmental Assessment and Construction Guidelines (both adopted and draft versions);
- Smith, G. F., O'Donoghue, P., O'Hora, K., Delaney, E., 2011. Best Practice Guidance for Habitat Survey and Mapping. The Heritage Council, Kilkenny.

Studies were also carried out in accordance with the following legislation:

- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive) and Directive 2009/147/EC (codified version of Directive (79/409/EEC as amended (Birds Directive)) – transposed into Irish law as European Communities (Birds and Natural Habitats) Regulations 2011;
- EU Environmental Impact Assessment (EIA) Directive (2011/92/EU as amended by 2014/52/EU);
- European Communities (Environmental Liability) Regulations, 2008 (S.I. No. 547 of 2008);
- European Communities (Quality of Salmonid Waters) Regulations, 1988 (S.I. No. 84 of 1988);
- Flora Protection Order, 2015;
- Planning and Development Act, 2000 (as amended);
- Water Framework Directive (2000/60/EC); and
- Wildlife Act 1976, as amended.

The following guidelines in relation to bats were referenced:

- Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation (Nature Scot, 2021)
- Bat Survey Guidelines: Traditional Farm Buildings Scheme (Aughney et al., 2008)

- Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). (BCT/Collins, 2016) The Bat Conservation Trust, London
- Wind Turbine/Wind Farm Development Bat Survey Guidelines (Bat Conservation Ireland, 2012)
- Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes (NRA, 2006a)
- Bats and Onshore Wind Turbines – Interim Guidance (3rd Edition) (Carlin, 2014)
- Guidelines for the Treatment of Bats during the Construction of National Road Schemes (NRA, 2006b)
- Guidance on Bat Surveys, Assessment & Mitigation for Onshore Wind Turbine Developments (NIEA, Natural Environment Division, August 13th 2021)
- Bat mitigation guidelines for Ireland v2. Irish Wildlife Manuals, No. 134. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland (Marnell, F., Kelleher, C. & Mullen, E. (2022))
- Guidelines for Consideration of Bats in Wind Farm Projects (Rodrigues, 2008)
- Rodrigues, L. Bach, M. J. Cubourg-Savvage, B. Karapandza, D. Kovac, T. Kervyn, J. Dekker, A. Kepel, P. Bach, J. Collins, C. Harbusch, K. Park, B. Micevski, J. Minderman (2015): Guidelines for consideration of bats in wind farm projects - Revision 2014.EUROBATS Publication Series No. 6 (English Version) UNEP/EUROBATS Secretarist, Bonn, Germany.

9.2.2. Desk Study

Sources of published material that were consulted as part of the desk study for the purposes of the ecological impact assessment are as follows:

- Ecology Chapter of the EIS completed for the Permitted Development.
- National Parks & Wildlife Service (NPWS) natural heritage database for designated areas of ecological interest and sites of nature conservation importance within the study area and it's Zone of Influence;
- NPWS website (mapviewer; Article 17 mapping; FPO Bryophyte viewer);
- EIAR Biodiversity chapters for nearby development (accessed via EIA Portal);
- Review of Ordnance Survey maps and ortho-photography;
- Review of the National Biodiversity Data Centre (NBDC) database for records of rare and protected species within the 10km OS Grid Square the subject site is situated in (M13);
- Aerial Photography;
- 1:50,000 Ordnance Survey (OS) Map; Discovery Series; and
- Environmental Protection Agency mapping (https://gis.epa.ie/EPAMaps).

The primary source of data to inform the desk study for aquatic ecology was the detailed aquatic baseline report prepared by Conservation Services (CS, 2010) presented in Appendix 5B of the EIS for the Permitted Development.

In addition, a thorough desk-based search of available baseline information was undertaken to identify key aquatic values and/or sensitivities. Verified online information, plus published and unpublished literature and the scientific literature were consulted as appropriate. The following publicly available sources were utilised:

- Environmental Protection Agency (EPA) maps and data
- Water Framework Directive (WFD) maps and data (https://www.catchments.ie/)
- NPWS maps and data (https://www.npws.ie/maps-and-data)
- Geohive historical mapping (https://www.geohive.ie/)
- Ordinance Survey of Ireland maps
- Geological Survey of Ireland (GSI) mapviewer
- National Biodiversity Data Centre (NBDC) maps and data
- Inland Fisheries Ireland (IFI) and WFD fish survey data

9.2.2.1. Biological Water Quality

In Ireland, biological water quality is assessed using the Q-value metric. This system is based on field sampling and observations, which evaluates habitat quality and macroinvertebrate diversity and abundance to interpret ecological status as set out in Table 9-1.

Q-value rating of watercourses involves taking 2-minute, travelling kick-samples in a fast flowing (riffle) area of streams and identifying aquatic macroinvertebrate groups present. The abundance of each group and their sensitivity to pollution are then used to assign Q-value in accordance with published methods of Toner et al. (2005). The Ecological Quality Ratio (EQR) represents the relationship between the values of the biological parameters observed for a given body of surface water and the values for these parameters in reference (pristine) conditions applicable to that body. The EQR classifies sites according to ecological quality status as required by river basin management planning under the Water Framework Directive (WFD). It allows comparison of water quality status across the European Union since each member state has an EQR value for 'High'; 'Good', 'Moderate', 'Bad' and 'Poor', based on an intercalibration of boundaries between water quality categories (McGarrigle & Lucey, 2009). Under the Water Framework Directive (WFD) all surface waters must be maintained or restored to at least Good Ecological Status (Q4). High status waters (Q4-5 and Q5) must not suffer deterioration.

Table 9-1: Q-value relationship to water quality and WFD status

Q-value	EQR	Quality Description	Water Quality	[1]WFD Ecological Status
Q5	1.0	Unpolluted	Good	High
Q4-5	0.9	Unpolluted	Fair-to-Good	
Q4	0.8	Unpolluted	Fair	Good
Q3-4	0.7	Slightly Polluted	Doubtful-to-Fair	Moderate

[1] Status assigned in this report is "potential" WFD status as it is not part of the EPA's formal WFD river monitoring programme.

Q3	0.6	Moderately Polluted	Doubtful	Poor
Q2-3	0.5	Moderately Polluted	Poor-to-Doubtful	
Q2	0.4	Seriously Polluted	Poor	Bad
Q1-2	0.3	Seriously Polluted	Bad-to-Poor	

The Q-value provides a more long-term indication of watercourse conditions, in contrast to snap-shot water chemistry analysis, which provides useful information for that moment in time. The Q-value assists in the detailed characterisation of water and habitat quality given that water quality is the primary determinant of habitat quality for aquatic organisms.

9.2.2.2.Physico-chemical Sampling

Key sites on watercourses were sampled for physico-chemical analysis. Results are set out in Chapter 8 (Water). Along with expert knowledge of water chemistry indicators on the particular geology and soil type, physico-chemical results are interpreted in this assessment with respect to legally binding national standards (EQS) under Surface Water Regulations to support the achievement of high and good ecological status, as set out in Table 9-2. Water quality is examined in the context of biodiversity given it is a primary determinant of habitat quality for aquatic organisms.

Table 9-2: Physico-chemical boundary values for Irish rivers (S.I. 77 of 2019)

	High Status	Good Status
MRP (mg P/l)	≤ 0.025 (mean) and ≤ 0.045 (95%ile)	≤ 0.035 (mean) and ≤ 0.075 (95%ile)
Ammonia (mg N/l)	≤ 0.040 (mean) and ≤ 0.090 (95%ile)	≤ 0.065 (mean) and ≤ 0.140 (95%ile)
BOD (mg O_2/l)	≤ 1.3 (mean) or ≤ 2.2 (95%ile)	≤ 1.5 (mean) or ≤ 2.6 (95%ile)
Dissolved Oxygen (% sat.)	80 -120%	

9.2.3. Consultation

Consultation with prescribed bodies was undertaken as described in Chapter 1, Section 1.4. No responses in relation to biodiversity have been received to date.

9.2.4. Designated Sites

A review of European designated sites within the likely zone of influence (15km radius) of the study area was undertaken (www.npws.ie) (following guidance within DoEHLG (2010) *Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities*. Department of the Environment, Heritage and Local Government). Applying the precautionary principle, designated sites located outside the 15km buffer zone were also taken into account and assessed. However, potential for effects on designated sites located outside the 15km buffer zone was not identified.

Special Areas of Conservation (SACs) are sites of international importance due to the presence of Annex I habitats and / or Annex II species listed under the EU Habitats Directive. Special Protection Areas (SPAs) are designated for birds based on the presence of internationally significant populations of listed bird species.

A review of nationally designated sites within a 15km radius of the study area was also undertaken. Natural Heritage Areas (NHAs) are sites deemed to be of national ecological importance and are afforded protection under the Wildlife Acts. The proposed Natural Heritage Area (pNHA) have not been statutorily proposed or designated; however they do have some protection under agri-environmental farm planning schemes such as Rural Environment Protection Scheme (REPS 3 and 4) and Agri Environmental Options Scheme (AEOS), Forest Service requirement for NPWS approval for afforestation grants in pNHA lands and recognition of the value of pNHAs by Planning and Licensing Authorities.

9.2.5. Field Study

9.2.5.1.Study Area

The study areas used for different disciplines and different survey types relative to different project elements (i.e. amendments to the permitted wind farm development, including amendments to the grid connection infrastructure, including underground cabling) are detailed below in Table 9-3. Please refer to Figure 1.1 of Chapter 1 for an illustration of the EIAR study area. While the wind farm and grid connection are both part of the Proposed Development, they have been presented separately in Table 9-3 for clarity.

Table 9-3: Definition of Study Areas

Discipline	Wind Farm	Grid Connection
Habitat, botanical and invasive species survey	EIAR study area.	EIAR study area and lands directly adjacent.
Amphibians	EIAR study area.	EIAR study area.
Ground mammals	150m buffer around infrastructure in open habitats; 50m buffer around felling areas.	EIAR study area and lands directly adjacent.
Otter	Length of watercourses within the study area	Accessible areas 200m up and downstream of the Abhainn na nArd Doiriú tributary stream crossing
Bats	Turbine locations	N/A

9.2.5.2. Habitats and Flora

The habitats within the portion of the study area incorporating the proposed grid connection cabling route were identified and classified, according to 'A Guide to Habitats in Ireland' (Fossitt, 2000). The habitat survey of the proposed grid connection cabling route was undertaken on 1st March 2023. All plant species present in each habitat type, and information on dominant species and plant assemblages were recorded. Habitats have been appraised and evaluated according to their occurrence as protected habitats under Annex I of the EU Habitats Directive (92/43/EEC) and for their capacity to support rare, threatened and endangered species. The

methodology used to assess the impact on habitats is based on NRA guidelines (2009 a and b), CIEEM guidelines (CIEEM, 2018) and EPA guidelines (EPA, 2022).

The habitat mapping exercise followed 'Best Practice Guidance for Habitat Survey and Mapping' (Smith et al., 2011) published by the Heritage Council.

A habitat survey within the portion of the study area incorporating the wind farm was also undertaken on 1st March 2023 to check whether there had been any changes to results of the habitat survey completed for the Permitted Development EIS.

Scientific and common names for vascular plants follow Stace (2019). In addition to habitat identification, each habitat was assessed for its ecological significance, based on the National Roads Authority (NRA) Site Evaluation Scheme (NRA, 2009a) (see Table 9-2).

Habitat boundaries and associated attribute data were mapped using desk-based GIS software, namely QGIS 3.10.

9.2.5.3. Amphibians

A frog survey was conducted on 1st March 2023 within suitable habitat within the study area in accordance with Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes (NRA, 2009b) and Surveying for Amphibians (Froglife, 2016).

The survey comprised a visual search for common frog in ditches and other areas of standing water looking for:

- Common frog in the water, including frog spawn, tadpoles and froglets

9.2.5.4.Mammals

Mammal surveys within the study area were undertaken on 1st March 2023. During surveys within the study area, the Project footprint was surveyed for signs of mammal activity; this included the footprint of vegetation clearance and earthworks plus a 150m buffer.

Sightings, tracks or signs (including droppings, resting places, burrows and setts) of mammals occurring within, or in the vicinity, of the Project footprint were recorded using field notes and/or handheld GPS units subsequently digitised using QGIS. The mammal survey also included a drey search within plantation woodland present within the study area.

Otter surveys were undertaken along the length of watercourses within the study area and within accessible areas 200m up and down-stream of the proposed underground cable crossing of the Abhainn na nArd Doiriú tributary stream on 1st March 2023.

Surveys were undertaken in accordance with the NRA's (2009b) 'Ecological Surveying Techniques for Protected Flora and Fauna During the Planning of National Road Schemes' and the JNCC's (2004) 'Common Standards Monitoring Guidance for Mammals'.

9.2.5.5. Bat Survey

A static detector survey was undertaken between 25th August and 5th September 2022 at the Proposed Development/ Permitted Development turbine locations. These results were analysed, and the statistical software 'R' was used to plot the results. 'R' was used to plot species recorded and activity time relative to sunset, with literature emergence times for each species. 'R' was also used to plot the median activity levels for each species, using bat passes per hour and activity levels from Matthews et al. (2016).

Data for typical emergence times for each species was obtained from the Bat Conservation Ireland (2021) Identification Guide to Ireland's bats. QGIS was used to interpret results in relation to locations and turbines, and recommendations provided based on outcomes.

9.2.6. Impact Assessment

The information gathered from desk study and survey has been used to prepare an ecological impact assessment (EcIA) of the Proposed Development upon the identified ecological features. The EcIA has been undertaken following the methodology set out in EPA (2022) (see Chapter 1 for further details) and CIEEM (2018) and with reference to BS 42020:2013. EcIA is based upon a source-pathway-receptor model, where the source is defined as the individual elements of the Proposed Development that have the potential to affect identified ecological features. The pathway is defined as the means or route by which a source can affect the ecological features. An ecological feature is defined as the feature of interest, being a species, habitat or ecologically functioning unit of natural heritage importance. Each element can exist independently however an effect is created where there is a linkage between the source, pathway and feature.

A significant effect is defined in CIEEM (2018) as:

"an effect that either supports or undermines biodiversity conservation objectives for 'important ecological features'…. or for biodiversity in general".

BS 42020:2013 states that if an effect is sufficiently important to be given weight in the planning balance or to warrant the imposition of a planning condition, e.g. to provide or guarantee necessary mitigation measures, it is likely to be "significant" in that context at the level under consideration. The converse is also true: insignificant effects would not warrant a refusal of permission or the imposition of conditions.

Likely significant effects are predicted on the basis of the Proposed Development as set out in Chapter 2 of this EIAR.

The valuation of ecological features is in accordance with the methodology detailed in National Roads Authority Guidelines (2009) (Table 9-4). To qualify as an ecological feature (referred to as key ecological receptors in the NRA Guidelines), features must be of local ecological importance (higher value) or higher as per the geographical frame of reference detailed in Table 9-4. Ecological features might also be important because they play a key functional role in the landscape as 'stepping-stones' for migratory species to move during their annual migration cycle, as well as for species to move between sites, to disperse populations to new locations, to forage, or move in response to climate change. Features of lower ecological value are not assessed.

Table 9-4: Geographical Frame of Reference for Ecological Evaluation

Ratings for Ecological Sites
International Importance: 'European Site' including Special Area of Conservation (SAC), Site of Community Importance (SCI), Special Protection Area (SPA) or proposed Special Area of Conservation. Proposed Special Protection Area (pSPA). Site that fulfils the criteria for designation as a 'European Site' (see Annex III of the Habitats Directive, as amended). Features essential to maintaining the coherence of the Natura 2000 Network. Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive. Resident or regularly occurring populations (assessed to be important at the national level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; and/or Species of animal and plants listed in Annex II and/or IV of the Habitats Directive. Ramsar Site (Convention on Wetlands of International Importance Especially Waterfowl Habitat 1971). World Heritage Site (Convention for the Protection of World Cultural & Natural Heritage, 1972). Biosphere Reserve (UNESCO Man & the Biosphere Programme). Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979). Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979). Biogenetic Reserve under the Council of Europe. European Diploma Site under the Council of Europe. Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988).
National Importance: Site designated or proposed as a Natural Heritage Area (NHA). Statutory Nature Reserve. Refuge for Fauna and Flora protected under the Wildlife Acts. National Park. Undesignated site fulfilling the criteria for designation as a Natural Heritage Area (NHA); Statutory Nature Reserve; Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park. Resident or regularly occurring populations (assessed to be important at the national level) of the following: Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Site containing 'viable areas' of the habitat types listed in Annex I of the Habitats Directive.
County Importance: Area of Special Amenity. Area subject to a Tree Preservation Order. Area of High Amenity, or equivalent, designated under the County Development Plan. Resident or regularly occurring populations (assessed to be important at the County level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance. County important populations of species or viable areas of semi-natural habitats or natural heritage features identified in the National or Local BAP, if this has been prepared. Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county. Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.
Local Importance (higher value): Locally important populations of Priority species or habitats or natural heritage features identified in the Local Biodiversity Action Plan (BAP), if this has been prepared; Resident or regularly occurring populations (assessed to be important at the Local level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality; Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value.
Local Importance (lower value): Sites containing small areas of semi-natural habitat that are of some local importance for wildlife; Sites or features containing non-native species that are of some importance in maintaining habitat links.

9.2.6.1. Aquatic Receptor Evaluation

The criteria used for assessment of ecological value of watercourses are adapted from NRA (now Transport Infrastructure Ireland (TII)) Ecological Impact Guidelines (NRA, 2003, 2009) involving careful consideration of fisheries value, water quality and consideration of contextual information for the resource at a geographic level. The evaluation criteria used to classify sites is shown in Table 9.5. This is mainly based on NRA (2003) guidelines which reference aquatic habitats or fisheries, with slight modifications based on NRA (2009) to set out criteria that classify aquatic habitat value within the study area. NRA (2003) guidelines provided more direction on classification of aquatic habitats, while NRA (2009) focused on terrestrial habitats. Only criteria with direct relevance to aquatic habitats and fisheries have been retained in Table 9.5**.** Baseline conditions and observations were assessed against the criteria in the context of national trends, guidelines and regulations and EU Water Framework Directive (WFD) criteria for ecological status, as appropriate. In the absence of any standards or guidelines, the scientific literature was consulted for direction.

Table 9-5: Ecological evaluation criteria (Adapted from NRA, 2003, 2009)

Relevant Criteria	Category
International Importance: ▪ Sites designated (or qualifying for designation) as an SAC. ▪ Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988) ▪ Major salmonid (salmon, trout, or char) lake fisheries	A
National Importance: ▪ Sites or waters designated or proposed as an NHA, Statutory Nature Reserve or National Park ▪ Undesignated sites containing significant numbers of resident or regularly occurring populations of Annex II species under the EU Habitats Directive ▪ Resident or regularly occurring populations (assessed to be important at the national level) of species protected under the Wildlife Acts; and/or species listed on Red Data Lists ▪ Major trout fishery rivers ▪ Waterbodies with major amenity fisheries value ▪ Commercially important coarse fisheries.	B
County Importance: ▪ Small water bodies with known salmonid populations or with good potential salmonid habitat, ▪ Undesignated sites containing any resident or regularly occurring populations of Annex II species under the EU Habitats Directive ▪ Large water bodies with some coarse fisheries value ▪ Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.	C
Local Importance (Higher Value): ▪ Small water bodies with some coarse fisheries value or some potential salmonid habitat. ▪ Any waterbody with unpolluted water (Q-value rating 4-5, Q5)	D
Local Importance (Lower value): ▪ Water bodies with no current fisheries value and no significant potential fisheries value.	E

9.3. Baseline Conditions

9.3.1. Designated Sites

The EIAR study area does not comprise any protected areas. There are eight European Sites within 15km of the study area. The Connemara Bog Complex SAC and pNHA is located c.124m to the south, Connemara Bog Complex SPA is located c.4.8km to the south-west; and Moycullen Bogs NHA is located c.1.5km to the south-east of the Proposed Development site. A review of nationally designated sites indicates that there are twelve sites designated for nature conservation within 15km of the Proposed Development site.

A list of European sites (Special Areas of Conservation (SACs) and Special Protection Areas (SPAs)) recorded within 15km of the Proposed Development site is presented in Table 9-6 and a list of nationally designated sites (Natural Heritage Areas (NHAs) and proposed Natural Heritage Areas (pNHAs)) is presented in Table 9-7. European Sites are illustrated in Figure 9-1 and nationally designated sites are illustrated in Figure 9-2.

A Natura Impact Statement for the Proposed Development, prepared in accordance with the requirements of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011) as amended and the Planning and Development Act (as amended), is presented separately to this EIAR and also accompanies this planning application.

Table 9-6: European sites located within a 15km radius of the Proposed Development site

Site Name and Code	Qualifying Interests	Distance from Proposed Development (km)[2]	Connectivity
Lough Corrib SAC (000297)	Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae) [3110] Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or Isoeto-Nanojuncetea [3130] Hard oligo-mesotrophic waters with benthic vegetation of Chara spp. [3140] Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation [3260] Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites) [6210]	6.4km	Remote indirect connectivity via an unnamed stream at the east of the site, which flows into Ross Lake and Woods SAC c.4.8km downstream and, in turn, flows into Lough Corrib SAC a further 4.7km downstream (i.e. a total of 9.5km downstream of the site).

[2] Straight line distance from site boundary

	Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae) [6410] Active raised bogs [7110] Degraded raised bogs still capable of natural regeneration [7120] Depressions on peat substrates of the Rhynchosporion [7150] Calcareous fens with Cladium mariscus and species of the Caricion davallianae [7210] Petrifying springs with tufa formation (Cratoneurion) [7220] Alkaline fens [7230] Limestone pavements [8240] Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [91A0] Bog woodland [91D0] *Margaritifera margaritifera* (Freshwater Pearl Mussel) [1029] *Austropotamobius pallipes* (White-clawed Crayfish) [1092] *Petromyzon marinus* (Sea Lamprey) [1095] *Lampetra planeri* (Brook Lamprey) [1096] *Salmo salar* (Salmon) [1106] *Rhinolophus hipposideros* (Lesser Horseshoe Bat) [1303] *Lutra lutra* (Otter) [1355] *Najas flexilis* (Slender Naiad) [1833] *Hamatocaulis vernicosus* (Slender Green Feather-moss) [6216]		
Gortnandarragh Limestone Pavement SAC (001271)	Limestone pavements [8240]	4.8km	No connectivity via surface water, groundwater or any other pathway.
Galway Bay Complex SAC (000268)	Mudflats and sandflats not covered by seawater at low tide [1140] Coastal lagoons [1150] Large shallow inlets and bays [1160] Reefs [1170] Perennial vegetation of stony banks [1220] Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]	12.2km	Tenuous remote and indirect connectivity via an unnamed stream at the east of the site, which flows into Ross Lake and Woods SAC Lough Corrib SAC before ultimately flowing into Galway Bay Complex SAC c.21.3km downstream.
	Salicornia and other annuals colonising mud and sand [1310] Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [1330] Mediterranean salt meadows (Juncetalia maritimi) [1410] Turloughs [3180] Juniperus communis formations on heaths or calcareous grasslands [5130] Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites) [6210] Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae [7210] Alkaline fens [7230] Limestone pavements [8240] *Lutra lutra* (Otter) [1355] *Phoca vitulina* (Harbour Seal) [1365]		
Connemara Bog Complex SAC (002034)	Coastal lagoons [1150] Reefs [1170] Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae) [3110] Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or Isoeto-Nanojuncetea [3130] Natural dystrophic lakes and ponds [3160] Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation [3260] Northern Atlantic wet heaths with *Erica tetralix* [4010] European dry heaths [4030] *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae) [6410] Blanket bogs (* if active bog) [7130] Transition mires and quaking bogs [7140] Depressions on peat substrates of the Rhynchosporion [7150] Alkaline fens [7230]	0.12km	Indirect connectivity via an unnamed watercourse crossed by the proposed grid connection cabling route, which flows into this SAC c.1.1km downstream.

	Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [91A0] *Euphydryas aurinia* (Marsh Fritillary) [1065] *Salmo salar* (Salmon) [1106] *Lutra lutra* (Otter) [1355] *Najas flexilis* (Slender Naiad) [1833]		
Ross Lake And Woods SAC (001312)	Hard oligo-mesotrophic waters with benthic vegetation of Chara spp. [3140] *Rhinolophus hipposideros* (Lesser Horseshoe Bat) [1303]	2.6km	Indirect connectivity via an unnamed stream at the east of the site, which flows into this SAC c.4.8km downstream.
Lough Corrib SPA (004042)	Gadwall (*Anas strepera*) [A051] Shoveler (*Anas clypeata*) [A056] Pochard (*Aythya ferina*) [A059] Tufted Duck (*Aythya fuligula*) [A061] Common Scoter (*Melanitta nigra*) [A065] Hen Harrier (*Circus cyaneus*) [A082] Coot (*Fulica atra)* [A125] Golden Plover (*Pluvialis apricaria*) [A140] Black-headed Gull (*Chroicocephalus ridibundus*) [A179] Common Gull (*Larus canus*) [A182] Common Tern (*Sterna hirundo*) [A193] Arctic Tern (*Sterna paradisaea*) [A194] Greenland White-fronted Goose (*Anser albifrons flavirostris*) [A395] Wetland and Waterbirds [A999]	7.4km	Remote indirect connectivity via an unnamed stream at the east of the site, which flows into Ross Lake and Woods SAC c.4.8km downstream and, in turn, flows into Lough Corrib SPA a further 5.8km downstream (i.e. a total of 10.6km downstream of the site).
Inner Galway Bay SPA (004031)	Black-throated Diver (*Gavia arctica*) [A002] Great Northern Diver (*Gavia immer*) [A003] Cormorant (*Phalacrocorax carbo*) [A017] Grey Heron (*Ardea cinerea*) [A028] Light-bellied Brent Goose (*Branta bernicla hrota*) [A046] Wigeon (*Anas penelope*) [A050] Teal (*Anas crecca*) [A052]	13.1km	Tenuous remote and indirect connectivity via an unnamed stream at the east of the site, which flows into Ross Lake and Woods SAC Lough Corrib SAC before ultimately flowing into Inner Galway Bay SPA c.21.9km downstream.
	Red-breasted Merganser (*Mergus serrator*) [A069] Ringed Plover (*Charadrius hiaticula*) [A137] Golden Plover (*Pluvialis apricaria*) [A140] Lapwing (*Vanellus vanellus*) [A142] Dunlin (*Calidris alpina*) [A149] Bar-tailed Godwit (*Limosa lapponica*) [A157] Curlew (*Numenius arquata*) [A160] Redshank (*Tringa totanus*) [A162] Turnstone (*Arenaria interpres*) [A169] Black-headed Gull (*Chroicocephalus ridibundus*) [A179] Common Gull (*Larus canus*) [A182] Sandwich Tern (*Sterna sandvicensis*) [A191] Common Tern (*Sterna hirundo*) [A193] Wetland and Waterbirds [A999]		
Connemara Bog Complex SPA (004181)	Cormorant (*Phalacrocorax carbo*) [A017] Merlin (*Falco columbarius*) [A098] Golden Plover (*Pluvialis apricaria*) [A140] Common Gull (*Larus canus*) [A182]	4.8km	No connectivity via surface water, groundwater or any other pathway.

Table 9-7: Nationally designated sites within a 15km radius of the Proposed Development site

Site Name and Code	Qualifying Interests	Distance from Proposed Development (km)[3]	Connectivity
Oughterard District Bog NHA (002431)	Peatlands [4]	1.9km	There is no surface water connectivity. The west of the Proposed Development site and this NHA are both located within the Spiddal Ground Waterbody. However, review of local topography indicates that groundwater at the Proposed Development site would not flow in the direction of this NHA.

[3] Straight line distance from site boundary

			No connectivity.
Moycullen Bogs NHA (002364)	Peatlands [4]	1.5km	There is no surface water connectivity. The east of the Proposed Development site and this NHA are both located within the Maam-Clonbur Ground Waterbody. However, review of local topography indicates that groundwater at the Proposed Development site would not flow in the direction of this NHA. No connectivity.
Ballycuirke Lough pNHA (000228)	No site synopsis available	6.5km	Remote indirect connectivity via an unnamed stream at the east of the site, which flows into Ross Lake and Woods SAC c.4.8km downstream and, in turn, flows into this pNHA a further c.4.2km downstream (i.e. a total of c.9km downstream of the site).
Connemara Bog Complex pNHA (002034)	See Connemara Bog Complex SAC	0.12km	Indirect connectivity via an unnamed watercourse crossed by the proposed grid connection cabling route, which flows into this SAC c.1.1km downstream.
Drimcong Wood pNHA (001260)	Drimcong Wood is situated approximately l.5km north-east of Moycullen, Co. Galway, in a limestone region. It is a mixture of deciduous and coniferous woodland. The scarcity of woodland in the west of Ireland in particular, as well as the good range of habitats, justifies the designation of this site as an NHA.	3.9km	Remote indirect connectivity via an unnamed stream at the east of the site, which flows into Ross Lake and Woods SAC c.4.8km downstream and, in turn, flows into this pNHA a further c1.5km downstream (i.e. a total of c.6.3km downstream of the site).
Furbogh Wood pNHA (001267)	Furbogh Wood is situated directly north of the Galway-Spiddle coast road, equidistant (3.5 km) from Spiddle and Barna at Furbogh. The site consists of oak (Quercus spp.) woodland bordering the Furbogh River. The site is	10.2km	No connectivity via surface water, groundwater or any other pathway.
	one of only a few Atlantic woodlands which occur directly adjacent to the coast. The occurrence of oak woodland on mineral soil is not a common feature of West Galway.		
Galway Bay Complex pNHA (000268)	See Galway Bay Complex SAC.	12.2km	Tenuous remote and indirect connectivity via an unnamed stream at the east of the site, which flows into Ross Lake and Woods SAC Lough Corrib SAC before ultimately flowing into Galway Bay Complex SAC c.21.3km downstream.
Gortnandarragh Limestone Pavement pNHA (001271)	See Gortnandarragh Limestone Pavement SAC	4.8km	No connectivity via surface water, groundwater or any other pathway.
Killarainy Lodge, Moycullen pNHA (002083)	This site is a nursery roost of the Natterer's Bat (*Myotis nattereri*).	5.3km	There is no connectivity via surface water. Habitat connectivity via features such as woodland, hedgerows and treelines is poor.
Lough Corrib pNHA (000297)	See Lough Corrib SAC and SPA.	7.4km	Remote indirect connectivity via an unnamed stream at the east of the site, which flows into Ross Lake and Woods SAC c.4.8km downstream and, in turn, flows into Lough Corrib SPA a further 5.8km downstream (i.e. a total of 10.6km downstream of the site).
Oughterard National School pNHA (002082)	This site consists of a two-storey primary school which is used as a nursery site by approximately 300 Leisler's Bat (Nyctalus leisleri).	7.9km	No connectivity via surface water, groundwater or any other pathway.
Ross Lake and Woods pNHA (001312)	See Ross Lake and Woods SAC.	2.6km	Indirect connectivity via an unnamed stream at the east of the site, which flows into this SAC c.4.8km downstream.

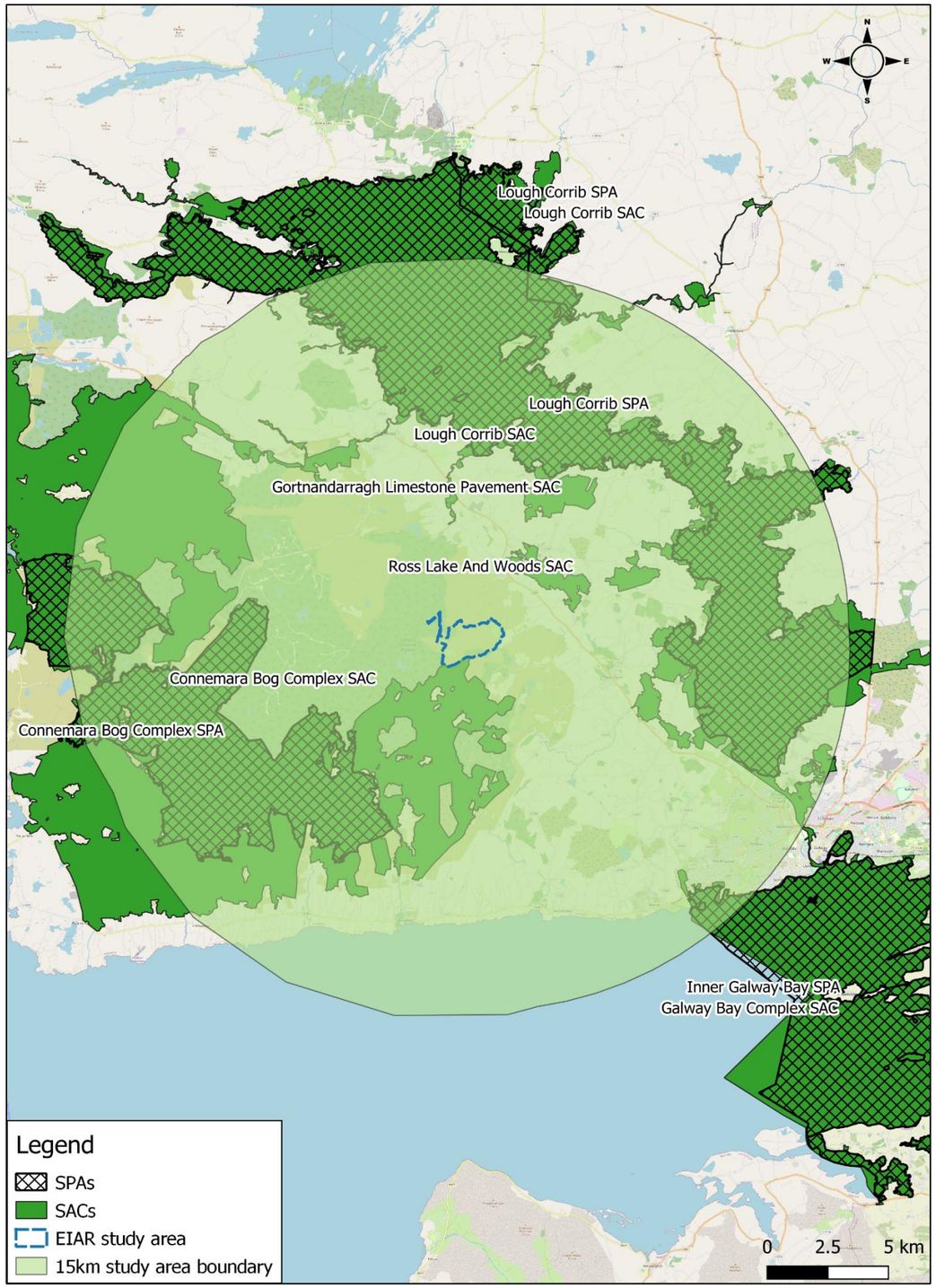

Figure 9.1 European sites within a 15km radius of the EIAR study area

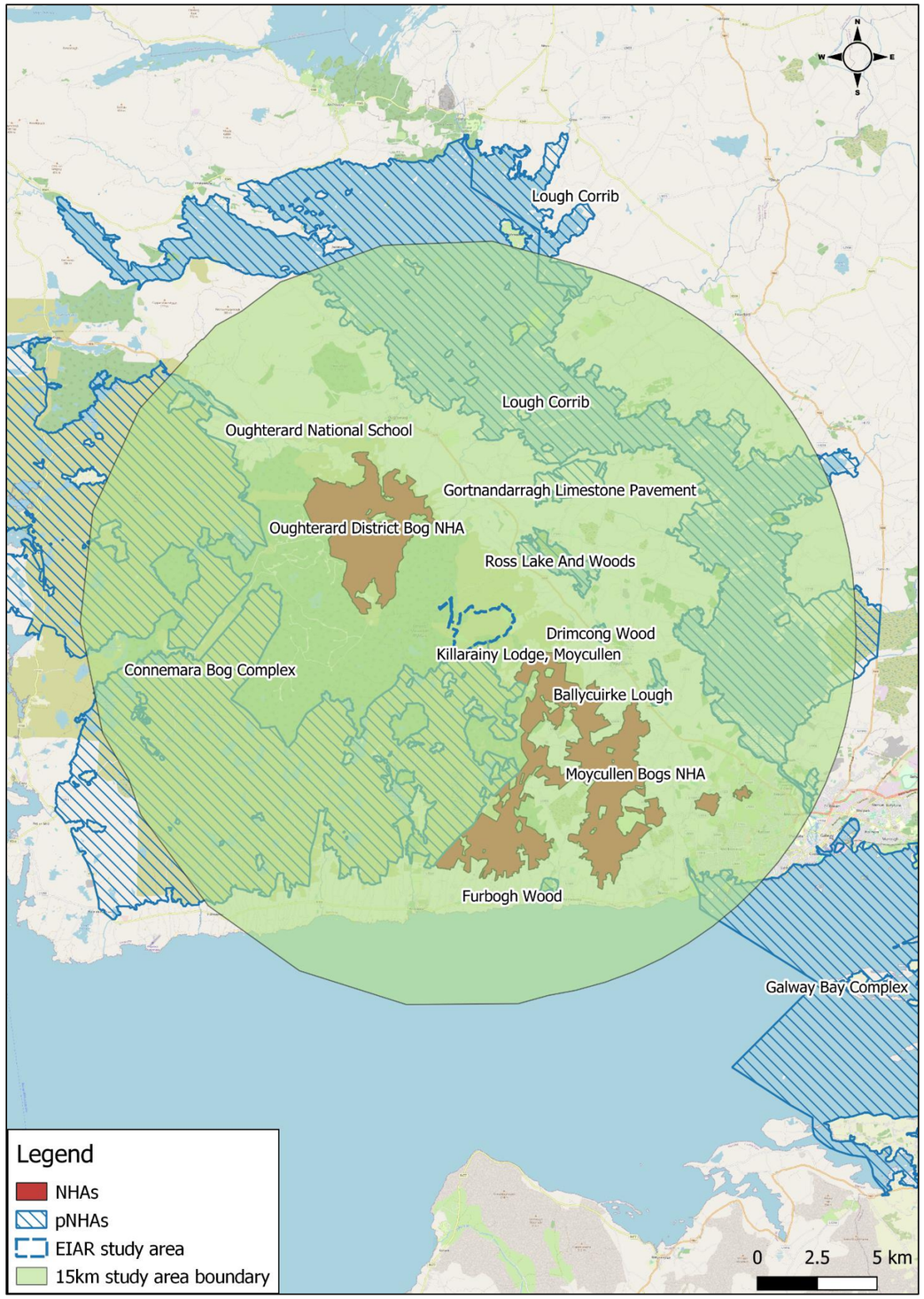

Figure 9.2 Nationally designated sites within a 15km radius of the EIAR study area

9.3.2. Habitats

This section describes the habitats present within the study area. An overview of habitats present within the already permitted wind farm study area is presented in Section 9.3.2.1. The proposed underground electrical and communications cabling connecting the 11 no. turbines to Ardderroo Substation (which is part of described proposed development) is discussed separately in this section as it is the only part of the development, as it relates to habitats, where there is any change in the baseline in comparison to the already permitted wind farm. A description of the habitats present within the proposed grid connection cabling route is presented in Section 9.3.2.2.

9.3.2.1. Wind Farm

The study area predominantly comprises wet heath and peatland habitats, with smaller areas of acid and improved agricultural grassland; two blocks of conifer plantation are also present.

These habitats are described in the following Sections and are mapped in Figure 9-3.

Rivers and streams (FW)

Rivers and streams within the study area are described in full in Section 9.3.4.

Reed Swamp (FS1)

Species poor reed- dominated swamp occurs as a transition zone between the Sruthán Buí and lowland blanket bog at the south-west of the study area. This area is considered to be a flushed area of blanket bog supporting stands of vegetation dominated by Common Reed.

Improved agricultural grassland (GA1)

Improved agricultural grassland occurs to the north-east of the site, with Soft Rush occurring locally in areas of poor drainage.

Dry-humid acid grassland (GS3)

Acid grassland within the site is associated with abandoned farmsteads, mainly in the south-western and western areas of the study area. Active farmland supporting acid grassland also occurs in the north-east and eastern areas of the study area. It predominantly occurs in mosaics with wet heath, dense bracken, wet grassland and scrub. Species present include Swett Vernal-grass (*Anthoxanthum odoratum*), Bents (*Agrostis* spp), Fescues (*Festuca* spp), Purple Moor-grass (*Molinia caerulea*), Heath Rush (*Juncus squarrosus*), Wood-rush (*Luzula* spp) and herbs including Tormentil (*Potentilla erecta*), Devil's-bit Scabious (*Succisa pratensis*), Yarrow (*Achillea millefolium*) and Lousewort (*Pedicularis sylvatica*).

Wet grassland (GS4)

Wet grassland occurs on flat or sloping ground or poorly drained soils. It occurs at the south-west of the site and in mosaics with acid grassland and dense bracken. Species present include Soft Rush (*Juncus effusus*), Purple Moor-grass and Common Haircap moss (*Polytrichum commune*).

Wet heath (HH3)

Wet heath extended over much of the study area and formed a mosaic with acid grassland to the east of the study area and blanket bog at the centre of the site. Exposed siliceous rock is also associated with this habitat. Species present within wet heath include Heather (*Calluna vulgaris*), Cross-leaved Heath (*Erica tetralix*), Heath Rush, Deer grass (*Trichophorum germanicum*), Purple Moor-grass, Cotton grasses (*Eriophorum angustifolium*), Wood Rush (*Luzula campestris*), Tormentil, Cup Lichens, Bog-mosses and Common Haircap moss.

Dense bracken (HD1)

Areas of dense bracken occurs in areas of past and current agricultural activity and are also associated with acid grassland, wet heath and wet grassland.

Lowland blanket bog (PB3)

For the most part, extensive areas of blanket bog were located in the lower flatter slopes at the study area boundaries to the south, west and north. Plant species present within the blanket bog at the south of the site included Bog Myrtle (*Myrica gale*), Cross-leaved Heath, Heather, Black Bog-rush (*Schoenus nigricans*), Cotton grasses, Purple Moor-grass, Bogbean (*Menyanthes trifoliata*), Common Butterwort (*Pinguicula vulgaris*), Common Sundew (*Drosera rotundifolia*), Heath Milkwort (*Polygala serpyllifolia*), Lousewort, Cup Lichens, Woolly Fringe-moss (*Racomitrium lanuginosum*) and Bog mosses. Blanket bog at the west of the site was less diverse and was dominated by Purple Moor-grass. Similarly, the blanket bog at the north-west and north of the site was dominated by Purple Moor-grass, with Heather, Cotton-grasses, *Sphagnum* mosses and Black Bog-rush also present.

Blanket bog forms mosaics with wet heath in the mid-west section of the site, with wet heath on the drier elevated ridges and blanket bog in the deeper depressions in the topography. Blanket bog also occurs in depressions in the topography on the eastern hill.

Degraded blanket bog is present in the north-eastern corner of the study area. This has been improved for agriculture and drained.

Cutover bog (PB4)

Historical cutover is predominantly located at the centre of the study area, with a smaller area of cutover bog at the north-east of the study area. These areas support wet heath and blanket bog vegetation, with a high cover of Purple Moor-grass. A series of deep drains have been excavated in the centre of the study area. To the west of the Abhainn na nArd Doiriú watercourse, the permitted underground cable route is located within an area of bog that was being actively cutover at the time of survey.

Poor fen and flush (PF2)

Small areas of poor fen and flush habitat are associated with the Sruthán Chnocán Ráithní and blanket bog or wet heath habitats. Poor fen and flush habitats are fed by groundwater or moving surface water.

Semi-natural broadleaved woodland

Semi-natural broadleaved woodland occurs on the eastern slopes of the study area. Two types of woodland occur, dry woodland on the upper better drained slopes and wet woodland on the lower waterlogged slopes.

Oak-ash-hazel woodland (WN2) occurs on dry and well drained sloping ground at the east of the study area. The woodland supported abundant Hazel (*Corylus avellana*), with Hawthorn (*Crataegus monogyna*), Oak (*Quercus* spp), Birch (*Betula* spp), Holly (*Ilex aquifolium*), and Mountain Ash (*Sorbus aucuparia*). The herb layer comprises ferns, Yellow Pimpernel (*Lysimachia nemorum)*, Violet (*Viola* spp), Primrose (*Primula vulgaris*), Honeysuckle (*Lonicera periclymenum*) and Lesser Celandine (*Ficaria verna*).

Wet woodland (WN6) occurs on peaty soils on the lower slopes of the access track at the east of the study area. Species present here include Birch, Willow, Hawthorn, Ash (*Fraxinus excelsior*) and Hazel, with Holly, Mountain Ash and Sycamore (*Acer pseudoplatanus*) also present. The ground layer comprises Mint (*Mentha* spp), Meadowsweet (*Filipendula ulmaria*), Violet, Ivy (*Hedera helix*), Meadow Buttercup (*Ranunculus acris*) and ferns.

Scrub (WS1)

Scattered patches of scrub within the site occur in a mosaic with acid grassland at the east of the study area. Species include Gorse (*Ulex europaeus*), Hawthorn, Blackthorn (*Prunus spinosa*), Hazel, Willows, Mountain Ash, Bramble (*Rubus fruticosus* agg) and Ivy.

Conifer plantation (WD4)

Conifer plantation occurs in two blocks within the study area, one at the north-west of the site and the other to the south. The block at the north-west is dominated by Lodgepole Pine and the southern block comprises a mix of Sitka Spruce and Lodgepole Pine.

Exposed siliceous rock (ER1)

Exposed siliceous rock within the study area comprises natural exposures of siliceous bedrock or loose rock. It occurs throughout most of the study area.

9.3.2.2. Grid Connection Cabling Route

The proposed grid connection cabling route predominantly comprises forestry, wind farm and local access roads, which are fringed by conifer plantation, wet grassland and scrub; active cutover bog is also present.

These habitats are described in the following Sections and are mapped in Figure 9-3.

Wet grassland and scrub (GS3/WS1)

The verge on the southern side of the road serving the Ardderroo substation supports relatively species poor wet grassland, with species present including Soft Rush (*Juncus effusus*), Compact Rush (*J. conglomeratus*), Common Sedge (*Carex nigra*), Purple Moor-grass (*Molinia caerulea*), Ribwort Plantain (*Plantago lanceolata*), Self-heal (*Prunella vulgaris*), Ox-eye Daisy (*Oxalis acetosella*) and bryophytes *Calliergonella cuspidata* and *Pseudoscleropodium purum*. Willow (*Salix* spp.), Gorse (*Ulex europaeus*) and Bramble (*Rubus fruticosus* agg.) scrub is scattered throughout the verge. This habitat is relatively species poor, is not of botanical importance and is considered to be of Local Importance (lower value).

Scrub WS1

Scrub is located to the south of the road serving the Ardderroo substation, dominated by Willow, with Alder (*Alnus glutinosa*), Gorse and Bramble are also present. This habitat is not of botanical importance but provides potential habitat for birds, small mammals and foraging bats and is considered to be of Local Importance (higher value).

Conifer Plantation (WD4)

Conifer plantation (predominantly Sitka Spruce) is located either side of the existing roads along the proposed grid connection cabling route; the proposed grid connection cabling route also clips the edge of an area of conifer plantation located to the south of the road serving the Ardderroo substation. This habitat is considered to be of Local Importance (lower value).

The conifer plantation to the east of the existing road is set back from the road, with a verge supporting wet heath and scrub growth present adjacent to the road. Purple Moor-grass is dominant here, with Willow and Bramble scrub scattered throughout. A small area of historical cutover bog is also present to the west of the existing road. This area supports species poor wet heath, with a high cover of Purple Moor-grass. These wet heath and cutover bog habitats are too small to map, and so have been included within the overall conifer plantation habitat.

Buildings and artificial surfaces (BL3)

This habitat is represented by the existing roads and the Ardderroo Substation compound. A highly disturbed habitat of negligible conservation importance.

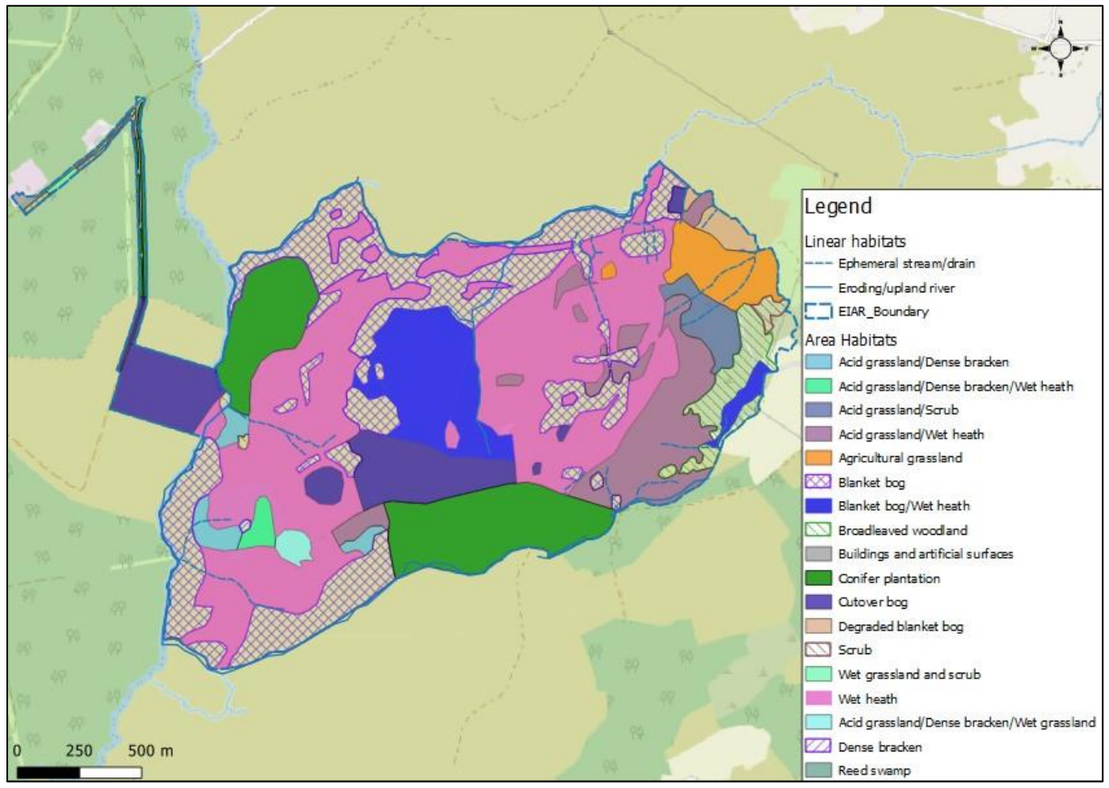

Figure 9.3 EIAR Study Area Habitat Map

9.3.3. Species

9.3.3.1. Flora

There are no records of protected species of vascular plants on the National Biodiversity Data Centre (NBDC) website for 10km OS grid square M13. The bryophyte *Leucobryum glaucum* (Large White-moss), which is listed on Annex IV of the EU Habitats Directive has been recorded c.2.4km west of the Proposed Development site, last recorded in 2014. *Leucobryum glaucum* was recorded within blanket bog within the study area during surveys undertaken to inform the EIS for the Permitted Development.

9.3.3.2. Amphibians

The NBDC database holds records of common frog from 10km OS grid square M13, last recorded at in 2020. Common frog (*Rana temporaria*) has also been recorded within a drainage ditch alongside the road to Ardderroo substation, last recorded at this location in 1994. Common frog and frog spawn was recorded during ecology surveys undertaken to inform the EIS for the Permitted Development.

Common frog spawn was recorded within drainage ditches at several locations alongside the forestry track and road serving the Ardderroo substation and also within a wet depression at the edge of forestry between the permitted locations of T3 and T6 during the site survey undertaken on 1st March 2023.

Smooth newt (*Lissotriton vulgaris*) has been recorded c.4km north-east of the study area at Brigit's Garden, Roscahill, last recorded in 2016. Habitat suitable for smooth newt is present at the site within larger ditches and standing water adjacent to the proposed grid connection cabling route. However, no evidence of smooth newt was recorded during the site survey undertaken on 1st March 2023.

9.3.3.3. Invertebrates

Kerry slug (*Geomalacus maculosus*) surveys were undertaken to inform the EIS for the Permitted Development. No Kerry slug was recorded within the study area.

The NBDC database holds records of Marsh Fritillary (*Euphydryas aurinia*) from within the study area at Knockranny, last recorded in 2016 to the north of the forestry block located at the south of the study area.

9.3.3.4.Mammals (other than bats)

Badger

The NBDC database holds several recorded of badger (*Meles meles*) from OS grid square M13, the latest of which is from 2018. The closest record to the Proposed Development site is from forestry located c.0.5km to the south-east, last recorded in 2007. No evidence of badger was recorded during the surveys undertaken to inform the EIS for the Permitted Development.

No evidence of badger was recorded during the survey undertaken within the study area on 1st March 2023.

Red Squirrel

Red squirrel (*Sciurus vulgaris*) has been recorded c.3.5km north-east of the Proposed Development site in Pollagh, last recorded in 2001.

No evidence of red squirrel was recorded during the surveys undertaken to inform the EIS for the Permitted Development. Likewise, no evidence of red squirrel was recorded during the survey undertaken within the study area on 1st March 2023.

Otter

The NBDC database holds several recorded of otter (*Lutra lutra*) from OS grid square M13, the latest of which is from 2010. The closest record to the Proposed Development site is from a stream below Uggool Lough, c.2.4km to the west, last recorded in 1980. Potential for otter to occur within the site was noted during the surveys undertaken to inform the EIS for the Permitted Development, but no field signs were recorded.

While there is potential for otter to occur within the study area, no evidence of this species was recorded during the survey undertaken within the study area on 1st March 2023.

Pine Marten

The NBDC database holds records of Pine Marten (*Martes martes*) from c.0.4km north of the site boundary, last recorded in 2020. No field signs of Pine Marten were recorded during the surveys undertaken to inform the EIS for the Permitted Development.

There is potential for Pine Marten to occur within the study area, however, no evidence of this species was recorded during the survey undertaken within the study area on 1st March 2023.

Other Species of Ground Mammal

Pygmy shrew (*Sorex minutus*) has been recorded c.3.9km north-east of the Proposed Development site in Rosscahill, last recorded in 2014.

The NBDC hold general records of red deer (*Cervus elaphus*) from within OS grid square M13 and this species has also been recorded c.2.7km to the south of the Proposed Development site, last recorded in 2016. No field signs of red deer were recorded during the surveys undertaken to inform the EIS for the Permitted Development.

Hedgehog (*Erinaceus europaeus*) has been recorded in Moycullen c.2.5km north-east of the Proposed Development site, last recorded in 2020. No field signs of hedgehog were recorded during the surveys undertaken to inform the EIS for the Permitted Development.

No evidence of pygmy shrew, red deer or hedgehog was recorded during the survey undertaken within the study area on 1st March 2023.

9.3.3.5. Bats

Desktop Study

The review of existing records of bat species indicates that five of the ten known Irish species of bat have been recorded within a 4km radius of the study area. These bats include pipistrelle species, soprano pipistrelle, Leisler's bat, Daubenton's bat and lesser horseshoe bat (Table 9-8). Of these species, lesser horseshoe bat has been recorded roosting in buildings within a 4km radius of the study area, outside of the study area boundary.

Table 9-8: Bat Species Recorded within a 4km Radius of the Study Area

Common Name	Scientific Name	Present (Y/N)	Date of Last Record	Location of Known Roost (to 1km OS Grid Square Resolution)
Pipistrelle spp.	*Pipistrellus pipistrellus sensu lato*	Y	14/09/2009	None
Soprano Pipistrelle	*Pipistrellus pygmaeus*	Y	14/09/2009	None
Nathusius's Pipistrelle	*Pipistrellus nathusii*	N	N/A	N/A
Leisler's Bat	*Nyctalus leisleri*	Y	14/09/2009	None
Brown Long-eared Bat	*Plecotus auritus*	N	N/A	N/A
Daubenton's Bat	*Myotis daubentonii*	Y	14/09/2009	None
Whiskered Bat	*Myotis mystacinus*	N	N/A	N/A
Natterer's Bat	*Myotis nattereri*	N	n/a	n/a
Lesser Horseshoe Bat	*Rhinolophus hipposideros*	Y	30/01/2015	M1737, M1935
Brandt's Bat	*Myotis brandtii*	N	n/a	n/a

The bat landscape association model (Lundy et al, 2011) suggests that the study area is part of a landscape that is of moderate to high suitability for bats including common pipistrelle (*Pipistrellus pipistrellus*), soprano pipistrelle, Leisler's, Daubenton's and natterer's bat; and is of low suitability for brown long-eared, lesser horseshoe, whiskered bat and Nathusius' pipistrelle.

Bat species recorded during the course of surveys undertaken in September 2010 to inform the EIS for the Permitted Development were common and soprano pipistrelle, a possible Leisler's bat and a *Myotis* species of bat. Bats were recorded using forest edges, river corridors, hedgerow, treelines and broadleaved woodland within and adjacent to the site.

Leisler's bat, brown long-eared bat, Myotis species, soprano pipistrelle, common pipistrelle and lesser horseshoe bat were recorded at Letter Lodge Outhouse during bat surveys undertaken to inform the EIAR for Ardderroo Wind Farm (McCarthy Keville O'Sullivan, 2018). The EIAR concluded that Letter Lodge Outhouse is likely used by a small number of individuals as a day, feeding or night roost. Letter Lodge Outhouse is located c0.1km to the west of Ardderroo substation.

Preliminary Habitat Assessment

Review of aerial photography and the results of the walkover completed in March 2023 indicate that the study area comprises wet heath and peatland habitats, with smaller areas of acid and improved agricultural grassland; two blocks of conifer plantation are also present. The Knockaunranny and Ardderroo watercourses run through the study area and small streams are also present on the southern and western boundaries of the study area. The watercourses and forestry edge habitats provide connectivity in the landscape and potential commuting routes to potential foraging areas in the wider landscape, such as broadleaved woodland to the east of the study area.

The foraging and commuting habitats at the study area are of moderate suitability for bats overall.

No potential roosting features for bats have been recorded within the study area.

Static Detector Survey 2022

The results of the static detector survey deployed between 25th August and 5th September 2022 are detailed below and the Interpretation of Bat Survey Results (APEM, 2023) is enclosed in Appendix 9-3.

Activity Levels

As detailed in Table 9-9, median values of bat passes at each turbine location per hour indicate that the highest number of bat passes/hour were seen for detectors located at turbines T1 and T3. These passes are primarily from the two most common pipistrelle species in Ireland: common and soprano. There were also relatively high passes found at detectors located at turbines T8 and T9. There was a higher spread for bat passes/hour for common and soprano pipistrelles at detectors located at turbines T1 and T3. This indicates that during some hours, there was a relatively high number of bat passes exceeding 10. For the detector at T1, the hours with the highest numbers of passes were around sunrise and sunset. The same can be said for the detector at turbine 3, but the highest number of passes are just before and at sunrise. There was also a very high number of bat passes/hour at turbine 1. The highest species richness however was found at the detector located at turbine 9. This turbine is located to the north of the site, just east of a conifer plantation edge. The lowest activity was recorded at the detector located at turbine 2.

Mathews et al (2016) class 50+ bat passes per night as high levels of activity. This was adapted per hour, using an average of 10 hours per night as an appropriate measure for sunset to sunrise for the time of year (early Autumn), and used in the current assessment of results. Low activity is ≤9 passes (≤1.99 passes/hour), moderate activity is given as 10-49 passes (2-4 passes/hour) and high activity is >50 passes (>5 passes/hour). The median passes per hour per detector was calculated using 'R' for each species and this is outlined in Table 9-9**.** Common pipistrelle showed the most variation as well as highest activity levels across all species, with soprano pipistrelles the next highest in median activity.

Table 9-9: Median activity levels (passes per hour) for each species recorded across all detectors

Species	Detector / Turbine										
	1089/T1	378/T2	1049/T3	3653/T5	1075/T6	1079/T7	1145/T8	1071/T9	1303/T11	1073/T13	3673/T14
CP	7	1	3	1	1.5	2	2	2	2	1	2
SP	2	1	4	1	1	2	2	2	2	1	2
Leis	2	1	1	1	1	1	2	1	1	1	1
Myo	1	2	1	1	1	1	1	1	1	1	1
NP	-	-	-	-	-	1	1	1	-	-	-
BLE	1	1	2	1	1	1	1	1	1	1	1
LHS	1	-	1	-	1	-	-	1	-	-	1

**CP (Common pipistrelle); SP (Soprano pipistrelle); Leis (Leisler's bat); Myo (Myotis species); NP (Nathusius' pipistrelle); BLE (Brown long-eared bat); LHS (Lesser Horseshoe Bat).*

In summary, a moderate level of activity for common pipistrelle was recorded at turbines T3, T7, T8, T9, T11 and T14 and a high level of activity was recorded at turbine 1. A moderate level of soprano pipistrelle activity was recorded at turbines T1, T3, T7, T8, T9, T11 and T14. A moderate level of Leisler's bat activity was recorded at turbines T1 and T8. A moderate level of *Myotis* species activity was recorded at turbine T2 and a moderate level of brown long-eared bat activity was recorded at turbine T3. A low level of Nathusius' pipistrelle activity was recorded at turbines T7, T8 and T9 and a low level of lesser horseshoe bat activity was recorded at turbines T1, T3, T6, T9 and T14.

Indication of Potential Bat Roost Presence

Most activity across the site is attributed to common pipistrelle. This species also shows the highest potential for roost site(s) located in the vicinity of the detector locations, with connectivity to this area. These are located at turbines T1, T3, T6, T8 and T13. The second species with the highest activity is soprano pipistrelle, followed by Leisler's bat. Based on the results, it is noted that there is likely a potential roost site for these species in the wider area, with commuting routes leading to the detector locations on the site. Soprano pipistrelle showed connectivity with commuting routes in the vicinity of all turbine locations, except for turbines T3 and T5. There is the potential for Leisler's roost(s) to be in the vicinity of turbines T1, T8 and T13.

The site has been identified as a foraging area for common pipistrelle, soprano pipistrelle, Leisler's bat and brown long-eared bat, with potential lower levels of foraging demonstrated by *Myotis* sp. A summary of the results is provided below in Table 9.10.

Table 9-10: Summary Static Detector Results, 2022

Detector/Turbine	Potential Roost in Vicinity with Connectivity (Species)	Potential Foraging in Vicinity (Species)	Potential Commuting in Vicinity (Species)
1089/T1	CP, Leis	CP, SP, Leis, BLE	SP, LHS, Myo
378/T2		SP, BLE	SP, CP, BLE, Leis, Myo
1049/T3	CP	CP, BLE, SP, Leis, Myo	LHS, Myo
3653/T5		SP, CP, BLE	CP, Leis, Myo
1075/T6	CP	SP, CP, BLE, Leis	SP, CP, Leis, Myo, LHS
1079/T7		SP, CP, BLE	CP, Leis, Myo, SP
1145/T8	CP, Leis	SP, CP, BLE, Leis	NP, SP, CP
1071/T9		SP, CP, BLE	SP, Myo, NP, BLE, Leis
1303/T11		SP, CP, BLE, Myo	CP, SP, BLE, Leis, Myo
1073/T13	CP, Leis	SP, CP, BLE, Leis	CP, SP, Leis, Myo
3673/T14		SP, CP, Leis, BLE	Leis, CP, SP, Myo, BLE

**CP (Common pipistrelle); SP (Soprano pipistrelle); Leis (Leisler's bat); Myo (Myotis species); NP (Nathusius' pipistrelle); Pip (Pipistrellus sp.); BLE (Brown long-eared bat); LHS (Lesser Horseshoe Bat).*

It is considered most likely that potential roosts in the vicinity of the site would be located to the east of the site. As noted previously, there is connectivity between a suitable broadleaf area of habitat, with building structures also present in this area, to turbine / detector locations that recorded activity during typical emergence window for common pipistrelle and Leisler's bat. For turbines T8 and T13 to the north, the likely commuting corridor would be located along the Knockaunranny stream, providing a linear feature in the landscape, and passing close to both of these detector locations. To the south, turbines T1, T3 and T6 are located along a potential commuting route comprising an access track along the edge of a conifer plantation. This also provides a commuting route from the broadleaf area to the east of the site and it is likely that bats use this to travel to foraging grounds to the west, such as the Owenboliska River, Naweelan Lough or towards to the Ardderroo Wind Farm. Turbines T14 and T9 located to the north-west are also along a conifer plantation edge which is likely to be a commuting corridor, also located close to the Owenboliska River. Turbines T7, T11, T5 and T2 are in open habitats with little linear features or connectivity and are likely therefore to be the least attractive to bats for commuting, in the context of the surrounding landscape.

9.3.4. Aquatic Ecology

9.3.4.1. Overview of Watercourses Potentially Affected

The Proposed Development straddles two EPA delineated sub-catchments:

- BallycuirkeLoughStream_SC_010 (30_14) within the greater Corrib catchment
- Owenboliska_SC_010 (31_6) within the greater Galway Bay North catchment

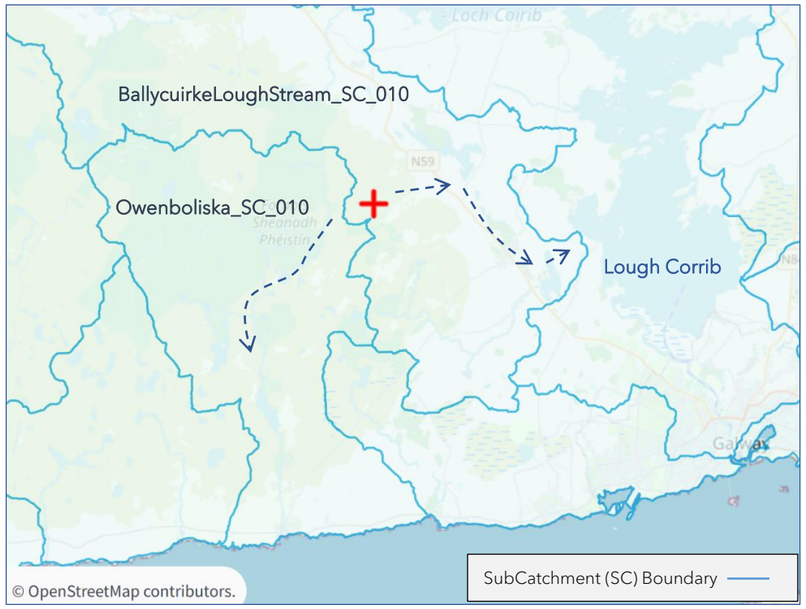

Figure 9.4 : Location of Cnoc Raithní Wind Farm showing relevant EPA sub-catchments

Fig. 9-4 shows flow direction from the Proposed Development into the relevant EPA sub-catchments. Table 9-11 lists the watercourses draining the Proposed Development along with EPA River Water Body (RWB) codes and reported status (2016-2021).

Ballyquirke Lough Stream Sub-catchment: The Proposed Development site is drained generally eastwards via upper headwaters of 'Sruthan Chnocan Raithní' (EPA name 'Knockaunranny') and the 'Lough Aderreen Stream' (EPA name 'Eochaire'), a tributary of Knockaunranny Stream. The Knockaunranny Stream flows into lower Ross Lake, discharging via Ballyquirke Lough Stream, Ballyquirke Lough and into Lough Corrib.

Owenboliska Sub-catchment: The Proposed Development site drains predominantly south-westwards via the 3rd order 'Abhainn na nArd Doiriú' (EPA un-named). A small 2nd order stream 'An Sruthán Bui' (EPA name 'Cnoc Raithní') flows along the southern site boundary meeting the Abhainn na nArd Doiriú. Two small, unnamed streams also join the Abhainn na nArd Doiriú, one draining the northwestern site boundary, near proposed T9, and one that is crossed by the proposed grid connection cabling Route. A further 1st order stream (EPA name 'Leitir') lies to the south of the Ardderroo substation, with surface drainage piped under the substation access road then flowing via low gradient topography towards this watercourse.

Table 9-11: Watercourse Naming and EPA RWB status

Local Name	EPA Stream Name	Stream Order	EPA RWB Name	EPA RWB Code	EPA Status (2016-2021)	Status Technique
Sruthan Chnocan Raithní	Knockaunranny	2	Knockaunranny Stream_010	IE_WE_30K020200	Good	Monitored
Upper Eochaire	[tributary of] Eochaire	1	Knockaunranny Stream_010	IE_WE_30K020200	Good	Monitored
Sruthan Bui	Cnoc Raithní	2	Owenboliska_010	IE_WE_31O010200	Moderate	Monitored
Abhainn na nArd Doiriú	Un-named	3	Owenboliska_010	IE_WE_31O010200	Moderate	Monitored
Leitir	Leitir	1	Owenboliska_010	IE_WE_31O010200	Moderate	Monitored

The EPA delineated watercourses relevant to this assessment are marked on Fig. 9-5, which shows the Proposed Development in relation to the channels.

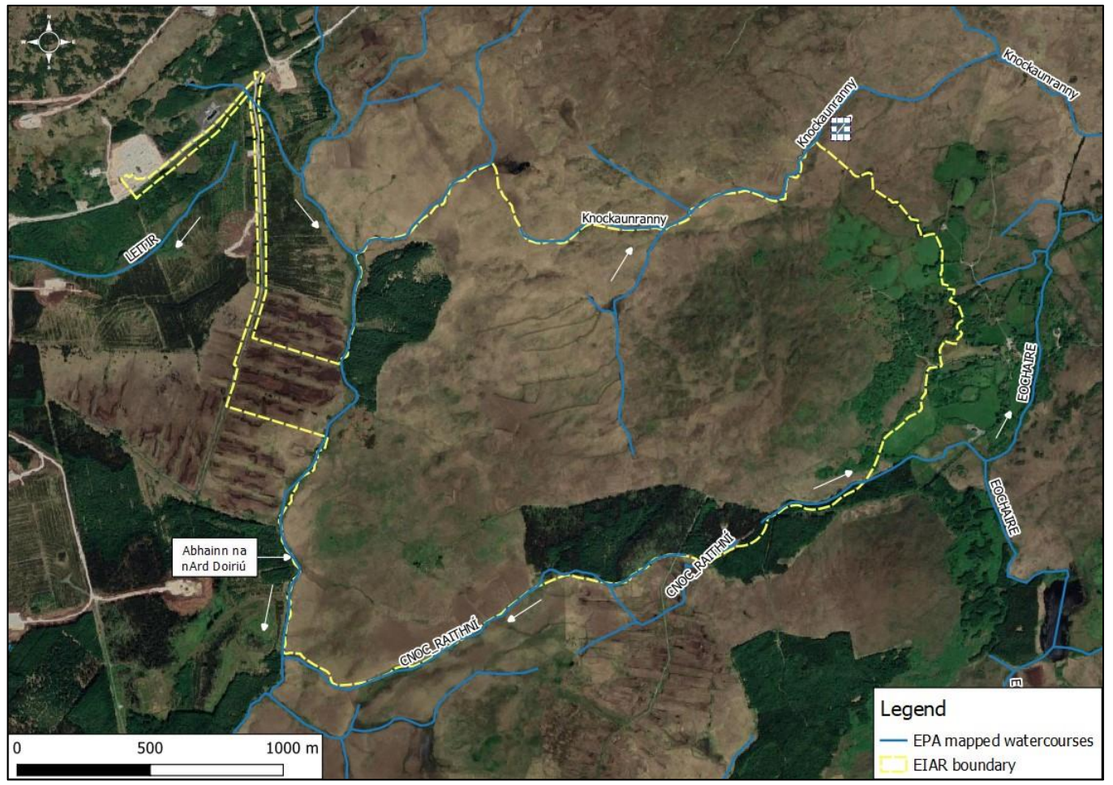

Figure 9.5 : Map of watercourses in relation to the EIAR Study Area

9.3.4.2. Ballycuirke Lough Stream Sub-catchment Watercourses

Upper Knockaunranny: The headwater channels of this stream are small 1st and 2nd order channel reaches within the Proposed Development site, forming narrow bog drains with mainly soft peaty detritus substrates. They are low quality channels, covered in heavy iron bacterial deposits with no salmonid spawning habitat and little or no nursery habitat potential. These upper channels are unsuitable for salmon, lamprey or freshwater pearl mussels. *Category E – Local Importance (lower value).*

Lower Knockaunranny Stream: Circa 1.7km downstream from the Proposed Development site boundary, the stream forms silty riffle-glide habitats comprising poor salmonid spawning potential, but fair nursery habitat for trout and brook lamprey. Another ~1 km downstream (at the N59) the stream size increases (after the confluence with Eochaire Stream) and comprises fair-to-good trout spawning and nursery habitat. The stream is unsuitable for salmon or freshwater pearl mussel, but silt deposits would be suitable for Brook lamprey (*Lampetra planeri*) nursery. *Category D – Local Importance (higher value).*

Upper Eochaire: One small headwater channel flows from near the permitted/ proposed T1 eastwards to meet the Eochaire Stream. The upper headwater is a low-quality forest drain with soft substrates and no fisheries significance. The channel steepens moving downstream to form an eroding step-pool habitat with small boulder-cobble substrates. The low gradient reach nearer the Eochaire main channel may have low density trout population (perhaps foraging up from the Eochaire), but is unsuitable for salmon, lamprey or freshwater pearl mussel. *Category E – Local Importance (lower value).*

Eochaire Stream: This is a tributary of Knockaunranny Stream that drains Lough Aderreen: a small, off-site upland lake to the east. The channel is ~4.0m in width as it nears the Knockaunranny confluence and comprises riffle-glide habitat over cobble and boulder, with native broadleaved scrub along much of the riparian zone. There is patchy trout spawning and good nursery habitats for trout. Brook lamprey could spawn in the channel, but there is no suitable lamprey nursery. Completely unsuitable for freshwater pearl mussel. *Category D – Local Importance (higher value).*

9.3.4.3. Owenboliska Sub-catchment Watercourses

Abhainn na nArd Doiriú: The main channel to the west of the Proposed Development site is ~4.0-5.0m wide, incised into deep peat and forming predominantly long, slow glides over soft, peaty substrates with heavy iron bacteria coating. Such habitat is unsuitable for salmonid spawning and nursery but may hold some older fish. A reach of ~200m near the permitted clear-span bridge crossing is of slightly higher gradient with step-pool and run-glide habitat over large boulders, with small proportion of cobble and no gravels. Salmonid spawning cannot be ruled out in the reach but the habitat is very sub-optimal. If salmonids did manage to spawn, the nursery habitat is fair-to-good. Banks are generally vertical peat with heath vegetation. Forestry lines the channel in the upstream reaches adjacent the Proposed Development turbines. The river flows southwards into Lough Ardderroo gradually improving near the inflow to the Lough, to form more natural riffle-glides over mixed stony substrates where salmonid spawning is limited, but nursery habitat is good. *Category D – Local Importance (higher value).*

Cnoc Raithní Stream: Small, 1st order, low-quality channel originating as a peat-lined drain within forestry near permitted / proposed T3. It flows sluggishly through open heath as a narrow bog drain (~50cm wide at most) with mainly peaty detritus substrates and some embedded muddy cobble. The channel intermittently broadens out through wet mire / swamp. There is no salmonid or lamprey spawning or habitat potential. *Category E – Local Importance (lower value).*

Leitir Stream: Small, 1st order, low-quality forestry drain that is currently piped under the access road leading to the Ardderroo substation. The Leitir drain eventually outfalls to Lough Naweelan 3.2km downstream of the proposed culvert crossing point on the ephemeral upper reach of this modified drain system. There is no salmonid or lamprey spawning or nursery habitat potential. *Category E – Local Importance (lower value).*

9.3.4.4. Biological Water Quality Summary

Table 9-12 lists EPA Q-value data for nearest long-term monitoring sites on the Knockaunranny Stream and Owenboliska River for the years 2003-2021.

Table 9-12: EPA Q-value Data 2003 – 2021

EPA River Station Code	EPA name	River Station	2003	2006	2009	2012	2015	2018	2021
30K020200	Knockaunranny	Bridge u/s Ross Lake	Q4-5	Q4	Q4	Q4	Q4	Q4	Q4
31O010100	Owenboliska	U/S Lough Boliska	Q4	~	~	~	~	~	Q4
31O010200	Owenboliska	Bridge in Spiddal	Q4-5	Q4	Q4-5	Q4-5	Q4-5	Q4-5	Q4

Knockaunranny: The single monitoring site in this stream was previously at 'high' status (Q4-5) but declined and remained at 'good' status (Q4) from 2006 to 2021 (most recent sampling). The stream is currently assigned good status hence is compliant with WFD objectives.

Owenboliska: There are 2 no. relevant EPA monitoring locations in this catchment**.** The site upstream of Lough Boliska (RS31O010100) is located ~6.5km downstream of the Proposed Development site and recently attained 'good' status (Q4), hence currently being compliant with WFD objectives. The site at the bridge in Spiddal is a further ~6.5km downstream, via Lough Boliska. Most recently the site recorded good status, a decline from mainly 'high status (Q4-5) for the previous 18 years. The decline from 'high' to 'good' status in recent monitoring is not compliant with WFD objectives.

9.3.4.5. Fisheries Data Review

Ballycuirke Lough Stream Sub-catchment: Two relevant sites in the Knockaunranny Stream catchment were electrofished by IFI staff in 2020 to assess the status of their fish stocks (Gordan et al., 2021). Standard 10-minute timed electro-fishing (TEF) technique was employed. One site was located on the Eochaire, and one on the Knockaunranny Stream between the N59 and Ross Lake (Fig. 9-6). Table 9-13 shows fish species and densities, plus WFD fish status for the sites. Trout were present in low densities at both sites, slightly higher at the Eochaire site. Salmon were absent at both sites. Lamprey (probably brook lamprey) were present on the lower Knockaunranny, as were coarse fish, the latter indicative of proximity to Ross Lake. The fish communities present do not merit 'good' status and hence fail WFD objectives for the fish quality element.

Figure 9.6 : WFD Electrofishing Sites – Knockaunranny Stream catchment

Table 9-13: Minimum density estimates (no. fish/m2) for relevant sites in Ballycuirke Lough Stream Sub-Catchment, 2020

Species	Eochaire	Knockaunranny	Owenboliska
Survey Year	2020	2020	2013
Brown trout	0.161	0.022	0.052
0+ brown trout	0.075	0.011	0.018
1++ brown trout	0.086	0.011	0.034
Salmon	_ _	_ _	0.057
0+ salmon	_ _	_ _	0.027
1++ salmon	_ _	_ _	0.029
European eel			0.009
Lamprey sp.	_ _	0.011	_ _
Perch	_ _	0.005	_ _
Roach	_ _	0.016	_ _
Stone loach	_ _	0.033	_ _
WFD Fish Status 2021	Moderate	Poor	Good

Owenboliska Sub-catchment: One site was electric fished by IFI on the Owenboliska River as part of the WFD surveillance river monitoring programme in 2013 (Kelly et al., 2014). The site was located approximately 1km north of Spiddal and sampled using a triple pass technique covering 38m of channel. Three fish species were recorded (Table 9-13), salmon being most abundant (n=58), followed by brown trout and European eel.

It is noted that the theoretical [4]Conservation Limit (CL) set for the Owenboliska River by the Standing Scientific Committee on Salmon (SSCS) is currently 592 salmon per annum. The salmon run in 2021 was at a deficit of -469 fish below the CL, meaning just 2.1% of the CL was met (Gargan et al., 2022). This means the numbers of returning fish are well below the carrying capacity of the system which usually reflects a combination of poor sea survival rates and/or issues with riverine spawning and nursery habitat quality.

9.3.5. Evaluation

Table 9-14 summarises all identified ecological features.

Approach to the ecological evaluation

Ecological features have been identified as being at risk of potentially significant impacts via a source-pathway-receptor link. Ecological features are valued as being of local ecological importance (higher value) or above as per the criteria set out in Table 9-14.

The habitat survey results and evaluation provided in the Permitted Development EIS were checked during the site survey undertaken on 1st March 2023 and have been included in Table 9-14. The species evaluation provided in the EIS for the Permitted Development has been updated based on the results of the desktop study and the results of surveys undertaken in 2022 and 2023, as detailed in the preceding Sections. .

Table 9-14: Evaluation of Ecological Features

Site/Habitat/ Species	Ecological Value[5]	Ecological Feature (Yes/No)
Designated Sites		
European Sites	The Proposed Development site supports connectivity to Lough Corrib SAC, Galway Bay Complex SAC, Connemara Bog Complex SAC, Ross Lake and Woods SAC, Lough Corrib SPA and Inner Galway Bay SPA. International Importance.	Yes
Nationally Designated Sites	The Proposed Development site supports connectivity to Ballycuirke Lough pNHA, Dimcong Wood pNHA, Galway Bay Complex pNHA, Lough Corrib pNHA and Ross Lake and Woods pNHA. National Importance.	Yes

[4] Scientifically derived sustainable stock level, i.e., the number of returning salmon that would be required to maintain the carrying capacity of the system based on its accessible area of fluvial habitat.

[5] In accordance with NRA (2009) Guidelines for the Assessment of Ecological Impacts of National Road Schemes Rev. 2. National Roads Authority

Habitats		
Wet Heath (HH3)	The habitat corresponds to northern Atlantic wet heaths with *Erica tetralix* and is quite extensive. National Importance.	Yes
Lowland blanket bog (PB3)	Lowland blanket bog within the site varies from good (i.e. supports typical species as listed in EU Habitat Interpretation Manual) to poor. National to County Importance.	Yes
Acid grassland GS3 (including mosaic habitats)	Habitat occupies a relatively extensive area in a mosaic with wet heath on the eastern slopes of the study area. This habitat contains a good diversity of species. Local- County Importance.	Yes
Wet grassland (GS4)	This habitat contains a good diversity of species and mosaics with other habitats of equal ecological value. Local Importance (higher value). Species poor grassland most closely corresponding to this habitat is present at the verge of the proposed grid connection cabling route. At this location, this habitat is of Local Importance (lower value).	Yes No
Poor fen and flush (PF2)	Poor fen and flush is limited in extent and associated with other habitat such as wet heath and streams. County Importance.	Yes
Semi-natural broadleaved woodland	Due to the prevalence of bog and heath habitat in the region, well developed examples of this habitat are relatively limited in extent in the County. County Importance.	Yes
Reed swamp (FS1)	Reed swamp is a transitional habitat between an open water stream and lowland blanket bog. County Importance.	Yes
Cutover bog (PB4)	These habitats are highly modified from their original state due to the loss of peat. Some areas of older cutover support wet heath vegetation. The proposed grid connection cabling route crosses a section of active turbary. County- Local Importance.	Yes
Rivers and streams	The watercourses within the study area are variable in Ecological Importance with some suitable habitat for Brook Lamprey recorded and Salmon spawning habitat downstream of the site as detailed in Section 9.3.5. Local Importance (lower-higher value).	Yes
Dense bracken (HD1)	This habitat is considered to be of low ecological value and is associated with past agricultural activity.	No
Scrub (WS1)	Scrub can be valuable bird habitat as well as having an inherent value. Local Importance (higher value).	Yes
Exposed siliceous rock (ER1)	Exposed siliceous rock supports extensive lichen cover and is associated mainly with wet heath. Local Importance.	Yes
Improved agricultural grassland (GA1)	This habitat is not semi-natural and has been improved for agriculture grazers (Local Importance (lower value).	No
Conifer plantation (WD4)	Conifer forest plantation supports low biodiversity and low levels of naturalness (Local Importance (lower value).	No
Buildings and artificial surfaces (BL3)	This habitat is highly disturbed and is of negligible ecological value.	No
Species		
Amphibians	Local Importance (higher value). Common frog was recorded within the wind farm and proposed grid connection cabling route study area. Smooth newt was not recorded during site surveys but suitable habitat is present.	Yes
Invertebrates	Local Importance (higher value). Marsh Fritillary has been recorded within the wind farm study area.	Yes
Badger	Local Importance (higher value). No evidence recorded during site surveys but suitable habitat is present.	Yes
Red Squirrel	Local Importance (higher value). No evidence recorded during site surveys but suitable habitat is present.	Yes
Otter	Evidence of otter has not been recorded within the study area, however otter may occur downstream and may utilise the watercourses within the study area as occasional foraging and commuting resource. Otter utilising the site are likely to be associated with the Connemara Bog Complex SAC, which adjoins the southern boundary of the study area. As such, otter has been assigned as being of International Importance.	Yes
Pine Marten	Local Importance (higher value). No evidence recorded during site surveys but has been recorded in the environs of the study area and suitable habitat is present.	Yes
Other species of ground mammal	Local Importance (higher value). No evidence of Irish Stoat or Pygmy Shrew recorded but study area is suitable.	Yes

Bats	Six species of bat and a further species from the *Myotis* genus were recorded within the study area during monitoring undertaken in 2022. As they occur within the study area, bats, excluding lesser horseshoe, are considered to be of at least Local Importance (higher value) on the basis of resident/locally occurring populations of Annex IV species and protected under the Wildlife Acts (as amended). Lesser horseshoe bat was recorded at the site in low numbers in 2022. The site is located outside the core sustenance zone (2.5km NPWS, Conservation Objectives supporting document – lesser Horseshoe bat. 2018) of bats associated with Ross Lake & Woods SAC, However, applying the precautionary principle, lesser horseshoe bats recorded may be associated with populations for which nearby SACs have been designated and therefore have been considered as Internationally Important receptors.	Yes
Atlantic Salmon	Salmonid habitat is poor in the Abhainn na nArd Doiriú adjacent to the Proposed Development, but valuable salmonid spawning and nursery habitats are present in the downstream Owenboliska River catchment.	Yes

9.4. Likely Significant Impacts

The construction phase impacts of the Permitted Development on biodiversity were assessed in the EIS submitted with that planning application. As detailed in Chapter 2 of this EIAR, the Proposed Development seeks to amend the Permitted Development.

The EIS for the Permitted Development fully assessed the likely significant effects of the 11 no. turbine layout and proposed mitigation measures to avoid or reduce these effects.

Of relevance to the Biodiversity Chapter, and as the baseline against which the Proposed Development is assessed, the following statements from An Bord Pleanala Reference 07.243094 are noted:

> *"The Board was satisfied that it could be concluded beyond reasonable scientific doubt that the proposed development including grid connection, either individually or in combination with other plans and projects, would not adversely affect the integrity of the European sites Connemara Bog Complex Special Area of Conservation (site code number 002034); Ross Lake and Woods Special Area of Conservation (site code number 001312)" [P. 14]*

> *"The Board completed an Environmental Impact Assessment and concluded that the proposed development, subject to compliance with the mitigation measures proposed, and subject to compliance with the conditions set out below, would not have unacceptable impacts on the environment." [P.17]*

Cnoc Raithní Wind Farm Site: The amendment comprises increased turbine tip height and removal of the previously permitted sub-station (area 2,271m^2). While the proposed turbine height is increasing, the location and area of hardstandings are not being altered as part of the Proposed Development. An increase of 2.45ha of coniferous forest felling is required over the 15.7ha of felling considered in the Permitted Development EIS (See Section 2.3.8 of Chapter 2 Project Description).

One crossing of the Abhainn na nArd Doiriú is required to access the site, involving a clear-span bridge with no instream works necessary. This crossing is already permitted and was agreed with Inland Fisheries Ireland (IFI). There are no changes to this permitted crossing and no other proposed watercourse crossings required on the wind farm site itself.

Grid Connection Cabling Route: proposed underground electrical and communications cabling connecting the 11 no. turbines to Ardderroo Substation involves an additional ~500m of grid connection cabling over what was previously assessed in the Permitted Development EIS. The Proposed Development involves 2 no. crossings of one minor, 1st order EPA delineated watercourse to connect to Ardderroo substation. One of these crossings involves the extension of an existing culvert to accommodate cabling, the other will be crossed via cabling laid within the existing road over the existing culvert. Though an EPA delineated watercourse, this watercourse is a highly modified forestry drain of low ecological significance which is a tributary of the Abhainn na nArd Doiriú. An additional 6 no. surface water drains pass beneath the existing access track along the proposed grid connection cabling route. These are not EPA delineated watercourses and have no fisheries significance. Four of these surface water drains eventually meet the upper Leitir stream, whilst two of them tenuously connect to the Abhainn na nArd Doiriú. Four of the six crossings of the surface drains involve the extension of an existing culvert to accommodate cabling, the other two will be crossed via cabling laid within the existing road over the existing culvert. The proposed grid connection cabling route also involves cabling installed within the clear-span crossing structure over the Abhainn na nArd Doiriú, with no requirement for instream works.

9.4.1. Do Nothing Scenario

If the Proposed Development were not to proceed the already permitted 11-turbine layout will proceed under the terms of the Galway County Council Planning Ref. No. 13/829 and An Bord Pleanála Ref: 07.243094 planning permission.

9.4.2. Assessment of Effects During Construction

9.4.2.1. Cnoc Raithní Wind Farm Site

Table 9-15 provides a summary of effects and impact significance of the proposed amendment application in comparison to the permitted wind farm project during the construction phase.

Table 9-15: Cnoc Raithní Wind Farm Site - Construction Phase Effects and Impact Significance

Site/Habitat/ Species	Ecological Evaluation	Characterisation of effect from proposed development	Impact Significance (without mitigation) compared to permitted project
Designated Sites			
European Sites	International Importance.	The potential for effects to occur in relation to European sites has been considered as part of the Natura Impact Statement accompanying the planning application. The findings presented in the NIS are that the Proposed	

		Development, by itself or in combination with other plans and projects, in light of best scientific knowledge, will not adversely affect the integrity of the relevant European sites and no reasonable scientific doubt remains as to the absence of such effects.	
Nationally Designated Sites	National Importance.	No changes that would affect nationally designated site.	Neutral
Habitats			
Wet Heath (HH3)	National Importance.	Reduction in the requirement for habitat loss owing to the removal of the substation.	Positive
Lowland blanket bog (PB3)	National to County Importance.	Reduction in the requirement for habitat loss owing to the removal of the substation.	Positive
Acid grassland GS3 (including mosaic habitats)	Local- County Importance.	No changes that would affect this habitat.	Neutral
Wet grassland (GS4)	Local Importance.	No changes that would affect this habitat.	Neutral
Poor fen and flush (PF2)	County Importance.	No changes that would affect this habitat.	Neutral
Semi-natural broadleaved woodland	County Importance.	No changes that would affect this habitat.	Neutral
Reed swamp (FS1)	County Importance.	No changes that would affect this habitat.	Neutral
Cutover bog (PB4)	County- Local Importance.	No changes that would affect this habitat.	Neutral
Rivers and streams	See Table 9-16.		
Scrub (WS1)	Local Importance (higher value).	No changes that would affect this habitat.	Neutral
Exposed siliceous rock (ER1)	Local Importance.	No changes that would affect this habitat.	Neutral
Species			
Amphibians	Local Importance (higher value).	No changes that would affect these species.	Neutral
Invertebrates	Local Importance (higher value).	No changes that would affect these species.	Neutral
Badger	Local Importance (higher value).	The construction of felling buffers for the increased turbine dimensions will lead to a permanent loss of c.2.45ha conifer plantation habitat (potential foraging and shelter for badger). However, no evidence of badger was recorded within the study area and conifer plantation habitat is widespread in the surrounding landscape, therefore this loss is not considered to be significant.	Permanent slight adverse effect on local populations
Red Squirrel	Local Importance (higher value).	The construction of felling buffers for the increased turbine dimensions will lead to a permanent loss of c.2.45ha conifer plantation habitat (potential foraging and shelter for red squirrel). However, no evidence of red squirrel was recorded in the study area and conifer plantation habitat is widespread in the surrounding landscape, therefore this loss is not considered to be significant.	Permanent slight adverse effect on local populations
Otter	International Importance	The proposed amendment is expected to result in a positive impact on the Abhainn na nArd Doiriú watercourse due to a reduction in potential emissions to surface water from the removal of sub-station. This, in turn, may result in a positive impact on otter populations of the Connemara Bog Complex SAC downstream owing to reduced levels of disturbance and a positive impact on water quality within their foraging and commuting range.	Positive
Pine Marten	Local Importance (higher value).	The construction of felling buffers for the increased turbine dimensions will lead to a permanent loss of c.2.45ha conifer plantation habitat (potential foraging and shelter for Pine Marten). However, no evidence of Pine Marten was recorded within the study area and conifer plantation habitat is widespread in the surrounding landscape, therefore this loss is not considered to be significant.	Permanent slight adverse effect on local populations

Other species of ground mammal	Local Importance (higher value).	No changes that would affect these species.	Neutral
Bats	At least Local Importance (higher value) and International Importance (lesser horseshoe bat)	There is potential for indirect impacts on bats due to increased disturbance during the construction phase and a reduction in insect prey species due to a reduction in foraging habitat (see additional text below).	Short-term moderate adverse effect on local bat populations.

Bats

The study area is comprised predominantly of wet heath and peatland habitats, with smaller areas of acid and improved agricultural grassland; two blocks of conifer plantation are also present. The Knockaunranny and Ardderroo watercourses run through the centre of the site and small streams are also present on the southern and western boundaries of the study area. The watercourses and forestry edge habitats provide connectivity to the wider landscape and commuting routes to foraging areas in the wider landscape, such as broadleaved woodland to the east of the study area. The foraging and commuting habitats at the study area are of moderate suitability for bats overall.

No potential roosting features for bats have been recorded within the study area, however potential roosting habitat within buildings is present to the east of the study area and a minor roost for Leisler's bat, brown long-eared bat, Myotis species, soprano pipistrelle, common pipistrelle and lesser horseshoe bat was recorded at Letter Lodge Outhouse during bat surveys undertaken to inform the EIS for Ardderroo Wind Farm (McCarthy Keville O'Sullivan, 2018).

The likely presence of roosts for common pipistrelle, soprano pipistrelle and Leisler's in the vicinity of the wind farm study area was indicated by analysis of the static detector results from 2022. The distance of potential roosts to the east and west of the study area from the closest turbine location (1.1km) and intervening buffer provided by woodland plantations and broadleaved woodland/scrub habitats mean that no direct or indirect impacts to potential roosts will occur during construction. The lack of potential roosting features within the main wind farm site means that no direct impacts to roosts will occur during construction. No loss of commuting routes associated with potential roosts to the east of the study area will occur.

The construction of felling buffers for the increased turbine dimensions will lead to a permanent loss of conifer plantation habitat within the study area. As noted above, no potential roosting features were recorded within the proposed study area. The felling of conifer plantation required for construction of turbines T1, T3, T9 and T14 will comprise felling of the edge of the plantation (rather than running thorough the forestry blocks). The additional felling required to facilitate the increased turbine size will result in a reduction in foraging area for bats but will not sever commuting routes.

In summary, there will be an alteration to commuting and foraging habitat as a result of the Proposed Development. There is potential for indirect impacts on bats due to increased disturbance during the construction phase and a minor reduction in insect prey species due to a reduction in foraging habitat. The impacts to bats during the construction phase will be a short-term moderate impact.

Aquatic Ecology

Table 9-16 provides a summary of effects and impact significance of the Proposed Development in comparison to the permitted wind farm project, as it relates to aquatic ecology.

Table 9-16: Cnoc Raithní Wind Farm Site - Aquatic Ecology Construction Phase Effects and Impact Significance

Watercourse	Fisheries Importance	Aquatic Qualifying Interests in ZoI	Characterization of Effect from Proposed Development	Impact Significance (without mitigation) compared to permitted project
Knockaunranny	Brown trout spawning and nursery in mid and lower reaches, Brook lamprey in lower reaches	Hard Water Lake Habitat 3140 (4km downstream)	No changes to surface water emissions (as permitted) that could affect aquatic ecological receptors	**Neutral**
Upper Eochaire	Brown trout spawning and nursery in mid and lower reaches, Brook lamprey in lower reaches	Hard Water Lake Habitat 3140 (4km downstream)	~0.4ha of additional forestry felling over the small area already permitted may cause marginal increases in suspended solids and/or phosphorus release to drains, but the effect will be imperceptible in downstream habitats for brown trout and macroinvertebrates which would experience slightly negative, temporary effects arising mainly from turbidity and perhaps ephemeral macroalgae growth.	**Imperceptible, temporary-to short term, reversible negative**
Cnoc Raithní	None	None	~1.2ha of additional forestry felling over the small area already permitted may cause marginal increases in suspended solids and/or phosphorus release to drains, but the effect will be neutral to imperceptible in the	**Imperceptible, temporary-to short term, reversible negative**

Watercourse	Fisheries Importance	Aquatic Qualifying Interests in ZoI	Characterization of Effect from Proposed Development	Impact Significance (without mitigation) compared to permitted project
			sluggish, swampy habitat of this stream. There may be imperceptible amounts of additional macroalgal growth in drains locally, but with no significant consequences either locally or further downstream	
Abhainn na nArd Doiriú	Patchy spawning and nursery habitat for Brown trout, with holding habitat for older fish. Some potential for salmon nursery	Acid Oligotrophic Lake Habitat 3110 (2km downstream) "Floating River Vegetation" Habitat 3260 (downstream) Atlantic salmon	Reduction in potential emissions to surface water owing to omission of permitted sub-station leading to reduced potential for downstream turbidity and/or sedimentation.	**Positive**

In comparison to what is currently permitted, the proposed turbine height is increasing, however the location and area of hardstandings are not being altered as part of the Proposed Development As such, the Proposed Development will not give rise to additional, alternative, or greater levels of pollutant discharge(s) to surface waters.

The removal of the permitted on-site Cnoc Raithní substation will result in a reduction in excavation to the original planning application of approximately 400m^3 of material during the construction phase on the wind farm site, which removes a potential source of construction phase sediment and water-borne pollutant loss to the Abhainn na nArd Doiriú and the Owenboliska Sub-catchment.

Hence, the proposed amendment does not introduce any additional likely significant effects, instead it reduces potential for adverse impact on downstream macroinvertebrates, trout, Annex II listed salmon, Annex I Habitats 3110 and 3260 of the Owenboliska sub-catchment.

9.4.2.2. Grid Connection Cabling Route

Table 9-17 provides a summary of effects and impact significance of the proposed amendment application in comparison to the permitted grid connection cabling route on ecological features of conservation importance during the construction phase. It is also noted that the road works to facilitate the electrical cabling may require the removal of conifer plantation of low conservation importance.

Table 9-17: Grid Connection Cabling Route - Construction Phase Effects and Impact Significance

Site/Habitat/ Species	Ecological Evaluation	Characterisation of effect from proposed development	Impact Significance (without mitigation) compared to permitted project
Designated Sites			
European Sites	International Importance.	The potential for effects to occur in relation to European sites has been considered as part of the Natura Impact Statement accompanying the planning application. The findings presented in the NIS are that the Proposed Development, by itself or in combination with other plans and projects, in light of best scientific knowledge, will not adversely affect the integrity of the relevant European sites and no reasonable scientific doubt remains as to the absence of such effects.	
Nationally Designated Sites	National Importance.	No changes that would affect nationally designated site.	Neutral
Habitats			
Rivers and streams	See Table 9-18.		
Scrub (WS1)	Local Importance (higher value).	Removal of scrub growth to the south of the road serving Ardderroo substation will be required. However, the area of removal is relatively small (c.0.72ha) and this habitat is widespread in the surrounding landscape.	Short term slight impact locally.
Species			
Amphibians	Local Importance (higher value).	Common frog spawn was recorded to the south of the road that services Ardderroo substation and alongside the forestry road at the location of the proposed grid connection cabling. In the absence of seasonal mitigation, spawning common frog or their young could (if present) be injured.	Potential impacts could be significant in the short term (1 to 7 years) but would be limited to the

			local geographic scale due to the localized area of impact.
Invertebrates	Local Importance (higher value).	No changes that would affect these species.	Neutral
Badger	Local Importance (higher value).	No changes that would affect these species.	Neutral
Red Squirrel	Local Importance (higher value).	No changes that would affect these species.	Neutral
Otter	Local Importance (higher value).	No changes that would affect these species.	Positive
Pine Marten	Local Importance (higher value).	No changes that would affect these species.	Neutral
Other species of ground mammal	Local Importance (higher value).	No changes that would affect these species.	Neutral
Bats	At least Local Importance (higher value).	The proposed grid connection cabling route will be located underground. No changes that would affect these species.	Neutral

Aquatic Ecology

Table 9-18 provides a summary of effects and impact significance of the proposed amendment application in comparison to the permitted grid connection cabling route, as it relates to aquatic ecology.

Table 9-18: Proposed Grid connection cabling Route - Aquatic Ecology Construction Phase Effects and Impact Significance

Watercourse	Fisheries Importance	Aquatic Qualifying Interests in ZoI	Characterization of Effect from Proposed Development	Impact Significance (without mitigation) compared to permitted project
Abhainn na nArd Doiriú	Patchy spawning and nursery habitat for Brown trout, with holding habitat for older fish. Some potential for salmon nursery	Acid Oligotrophic Lake Habitat 3110 (2km downstream) "Floating River Vegetation" Habitat 3260 (1.8km downstream) Atlantic salmon	No significant changes to surface water emissions that could affect aquatic ecological receptors. Low probability of localized effect in relation to culvert extensions on minor tributary which may temporarily affect macroinvertebrate diversity (but not overall sensitivity) for a short distance downstream of the tributary confluence. ~0.85ha of additional keyhole forestry felling over the small catchment area already permitted may cause marginal increases in suspended solids and/or phosphorus release to drains locally, but the effect will be imperceptible in downstream habitats of salmonids and macroinvertebrates which would experience slightly negative, temporary effects arising mainly from turbidity and perhaps temporary, ephemeral macroalgal growth.	**Imperceptible, temporary-to short term, reversible negative** both locally and in terms of further downstream aquatic ecological receptors
Unamed Abhainn na nArd Doiriú tributary	None	Acid Oligotrophic Lake Habitat 3110 (2.3km downstream) "Floating River Vegetation" Habitat 3260 (2.3km downstream) Atlantic salmon (300m downstream)	Temporarily elevated suspended solids for a short distance downstream of drain crossing and culvert extension may cause disturbance to macroinvertebrates, but no significant effects on wider fisheries or protected species value downstream	**Temporary, not significant, reversible negative**

Leitir	None	Acid Oligotrophic Lake Habitat 3110 (3km downstream) "Floating River Vegetation" Habitat 3260 (>2.5km downstream) Atlantic salmon (>2.5km downstream)	Temporarily elevated suspended solids may be detectable in the upper Leitir for a short time, but this minor drain has low ecological significance and there will be no effects on aquatic receptors	**Temporary, imperceptible, reversible negative** locally. **Neutral** in terms of further downstream aquatic ecological receptors.

9.4.3. Assessment of Effects During Operation

9.4.3.1. Cnoc Raithní Wind Farm Site

Designated Sites

The potential for effects to occur in relation to European sites has been considered as part of the Natura Impact Statement accompanying the planning application. The findings presented in the NIS are that the Proposed Development, by itself or in combination with other plans and projects, in light of best scientific knowledge, will not adversely affect the integrity of the relevant European sites and no reasonable scientific doubt remains as to the absence of such effects.

The Proposed Development, (as described in Chapter 2) will not involve any changes to operation phase activities, compared to those currently permitted, that could give rise to significant effects on nationally designated sites.

Habitats

The proposed amendments, comprising an increase in the tip height of turbines and the omission of the substation will not involve any changes to operation phase activities, compared to those currently permitted, that could give rise to significant effects on terrestrial habitats.

In relation to aquatic ecology, the Proposed Development, comprising increased turbine tip height does not involve any changes to operation phase maintenance or activities on the wind farm site (compared to those currently permitted) that could give rise to additional, alternative, or greater levels of pollutant discharge(s) to surface waters. The proposed omission of the on-site substation is likely to reduce the potential number of maintenance visits and light vehicle movements on the site during the operation phase. This slightly reduces potential sources of sediment and hydrocarbon emissions on the site during the operation phase and therefore, if anything, represents a reduction in potential for adverse effects on surface waters and downstream aquatic receptors.

The Proposed Development does not give rise to any additional potential for likely or significant operational phase effects on downstream aquatic receptors of either the Owenboliska or Ballycuirke Lough Stream Sub-catchments.

Species

Potential effects of the proposed amendments on fauna relate to the risk of adverse effects on airborne species (i.e. bats and birds) due to the increase in the turbine dimensions, as detailed below. No significant adverse effects on ground mammals will occur as a result of the Proposed Development.

Bats

Six species of bat were recorded within the study area during surveys undertaken in 2022, namely common pipistrelle, soprano pipistrelle, Leisler's bat, Nathusius' pipistrelle, brown long-eared, lesser horseshoe bat and a species from the *Myotis* genus. Table 9-19 details the collision risk factor for these species in relation to wind farms.

Table 9-19: Collision Risk for Bat Species Recorded within the Study Area (Nature Scot, 2021)

Species	Collision Risk
Common Pipistrelle	High
Soprano Pipistrelle	High
Nathusius' Pipistrelle	High
Leisler's Bat	High
Brown Long-eared Bat	Low
Lesser Horseshoe Bat	Low
Myotis Species	Low

According to the Nature Scot Guidelines (2021), wind farms can affect bats in the following ways:

- Collision mortality, barotrauma and other injuries (although it is important to consider these in the context of other forms of anthropogenic mortality)
- Loss or damage to commuting and foraging habitat, (wind farms may form barriers to commuting or seasonal movements, and can result in severance of foraging habitat);
- Loss of, or damage to, roosts;
- Displacement of individuals or populations (due to wind farm construction or because bats avoid the wind farm area).

To ensure that bats are protected by minimising the risk of collision, an assessment of impact at a site requires a detailed appraisal of:

- The level of activity of all bat species recorded at the site assessed both spatially and temporally.
- The risk of turbine-related mortality for all bat species recorded at the site during bat activity surveys.
- The effect on the species' population status if predicted impacts are not mitigated.

The above information should be interpreted in the context of likely impacts on local populations. Relevant factors that should be considered include whether populations are at the edge of their range, cumulative effects, presence of protected areas designated for their bat interest and proximity to maternity roosts, key foraging areas or key flight routes, including possible migration routes (Nature Scot, 2021).

In accordance with the Nature Scot Guidelines (2021), the Proposed Development site is classified as a Medium sized project (i.e. between 10 and 40 turbines) and the habitats present are of moderate risk (i.e buildings, trees or other structures with moderate-high potential as roost sites on or near the site and habitat that could be used extensively by foraging bats); this gives a site risk level of 3. The Nature Scot guidelines then recommend

calculating a risk assessment for each species at the site utilising bat activity output from Ecobat. EcoBat was not used in the current interpretation of results this tool was offline for maintenance at the time of preparing this report. For this assessment, the risk assessment matrix provided in the Nature Scot Guidelines has been adapted to assess bat passes per hour (using an average of 10 hours per night as an appropriate measure for sunset to sunrise for the autumn period) as detailed in Table 9-20. The scores in the table are a product of multiplying the site risk level (3) and the activity level. Overall assessment:

- Low (green)= 0-4
- Medium (amber)= 5-12
- High (red)= 15-25

Table 9-20: Risk Assessment Matrix

Site risk level (from Table 3a, Nature Scot, 2021)	Activity Category (adapted from Mathews *et al* (2016))					
	Nil (0)	Low (1 pass/ hour)	Low-moderate (2 passes/hour)	Moderate (3 passes/hour)	Moderate-high (4 passes/hour)	High (5 passes/hour)
Lowest (1)	0	1	2	3	4	5
Low (2)	0	2	4	6	8	10
Medium (3)	0	3	6	9	12	15
High (4)	0	4	8	12	15	18
Highest (5	0	5	10	15	20	25

The impact assessment is then carried out for individual turbines using the overall site assessment value (3) and is compared to the risk assessment matrix (Table 9-20) in order to determine the level of risk for bats at each turbine. The median activity level was used for this assessment.

2022 Survey Results

The median activity level for common pipistrelle at turbines T2, T5 and T13 have a low risk level. Turbines T3, T6, T7, T8, T9, T11 and T14 have a moderate risk level, while turbine T1 has a high risk level (Table 9-21).

Table 9-21: Risk Assessment at Turbine Locations for Common Pipistrelle

Bat detector ID/Turbine No	Site risk value	Median activity level	Turbine risk (site risk x median activity level)
1089/ T1	3	7	21
378/ T2	3	1	3
1049/ T3	3	3	9
3653/ T5	3	1	3
1075/ T6	3	1.5	4.5
1079/ T7	3	2	6
1145/ T8	3	2	6
1071/ T9	3	2	6
1303/ T11	3	2	6
1073/T13	3	1	3
3673/ T14	3	2	6

The median activity level for soprano pipistrelle at turbines T2, T5, T6 and T13 have a low risk level, while turbines T1, T3, T7, T8, T9, T11 and T14 have a moderate risk level (Table 9-22).

Table 9-22: Risk Assessment at Turbine Locations for Soprano Pipistrelle

Bat detector ID/Turbine No	Site risk value	Median activity level	Turbine risk (site risk x median activity level)
1089/ T1	3	2	6
378/ T2	3	1	3
1049/ T3	3	4	12
3653/ T5	3	1	3
1075/ T6	3	1	3
1079/ T7	3	2	6
1145/ T8	3	2	6
1071/ T9	3	2	6
1303/ T11	3	2	6
1073/T13	3	1	3
3673/ T14	3	2	6

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The median activity level for Leisler's bat at turbines T2, T3, T5, T6, T7, T9, T11, T13 and T14 have a low risk level and turbine 1 and turbine 8 have a moderate risk level (Table 9-23).

Table 9-23: Risk Assessment at Turbine Locations for Leisler's Bat

Bat detector ID/Turbine No	Site risk value	Median activity level	Turbine risk (site risk x median activity level)
1089/ T1	3	2	6
378/ T2	3	1	3
1049/ T3	3	1	3
3653/ T5	3	1	3
1075/ T6	3	1	3
1079/ T7	3	1	3
1145/ T8	3	2	6
1071/ T9	3	1	3
1303/ T11	3	1	3
1073/T13	3	1	3
3673/ T14	3	1	3

The median activity level for *Myotis* species at all turbines have a low risk level, with the exception of turbine 2, which has a moderate risk level (Table 9-24).

Table 9-24: Risk Assessment at Turbine Locations for Myotis Species

Bat detector ID/Turbine No	Site risk value	Median activity level	Turbine risk (site risk x median activity level)
1089/ T1	3	1	3
378/ T2	3	2	6
1049/ T3	3	1	3
3653/ T5	3	1	3
1075/ T6	3	1	3
1079/ T7	3	1	3
1145/ T8	3	1	3
1071/ T9	3	1	3
1303/ T11	3	1	3
1073/T13	3	1	3
3673/ T14	3	1	3

The median activity level for Nathusius' pipistrelle at all turbines have a low risk level (Table 9-25).

Table 9-25: Risk Assessment at Turbine Locations for Nathusius' Pipistrelle

Bat detector ID/Turbine No	Site risk value	Median activity level	Turbine risk (site risk x median activity level)
1089/ T1	3	0	0
378/ T2	3	0	0
1049/ T3	3	0	0
3653/ T5	3	0	0
1075/ T6	3	0	0
1079/ T7	3	1	3
1145/ T8	3	1	3
1071/ T9	3	1	3
1303/ T11	3	0	0
1073/T13	3	0	0
3673/ T14	3	0	0

The median activity level for Brown long-eared bat at all turbines have a low risk level (Table 9-26).

Table 9-26: Risk Assessment at Turbine Locations for Brown Long-eared Bat

Bat detector ID/Turbine No	Site risk value	Median activity level	Turbine risk (site risk x median activity level)
1089/ T1	3	1	3
378/ T2	3	1	3

1049/ T3	3	2	6
3653/ T5	3	1	3
1075/ T6	3	1	3
1079/ T7	3	1	3
1145/ T8	3	1	3
1071/ T9	3	1	3
1303/ T11	3	1	3
1073/T13	3	1	3
3673/ T14	3	1	3

The median activity level for lesser horseshoe bat at all turbines have a low risk level (Table 9-27).

Table 9-27: Risk Assessment at Turbine Locations for Lesser Horseshoe Bat

Bat detector ID/Turbine No	Site risk value	Median activity level	Turbine risk (site risk x median activity level)
1089/ T1	3	1	3
378/ T2	3	0	0
1049/ T3	3	1	3
3653/ T5	3	0	0
1075/ T6	3	1	3
1079/ T7	3	0	0
1145/ T8	3	0	0
1071/ T9	3	1	3
1303/ T11	3	0	0
1073/T13	3	0	0
3673/ T14	3	1	3

A summary of the risk assessment results for each turbine is presented Table 9-28.

Table 9-28: Risk Assessment Summary at Turbine Locations for Each Species Recorded

Detector ID/ Turbine No	Common Pipistrelle	Soprano Pipistrelle	Leisler's	*Myotis* spp	Nathusius' Pipistrelle	Brown Long-eared	Lesser Horseshoe
1089/ T1	21	6	6	3	0	3	3
378/ T2	3	3	3	6	0	3	0
1049/ T3	9	12	3	3	0	6	3
3653/ T5	3	3	3	3	0	3	0
1075/ T6	4.5	3	3	3	0	3	3
1079/ T7	6	6	3	3	3	3	0
1145/ T8	6	6	6	3	3	3	0
1071/ T9	6	6	3	3	3	3	3
1303/ T11	6	6	3	3	0	3	0
1073/T13	3	3	3	3	0	3	0
3673/ T14	6	6	3	3	0	3	3

Assessment of the results of the static detector monitoring undertaken in 2022 indicates that a high level of activity of one species of bat, namely common pipistrelle, was recorded at the location of turbine T1. A moderate level of common pipistrelle and soprano pipistrelle activity was recorded across the study area, with the exception of turbines T2, T5 and T13, which are all located within open wet heath/ blanket bog habitats. A moderate level of Leisler's bat activity was recorded at turbine 1 and turbine 8, at the east of the wind farm site. These species are all considered to be at high risk of collision (Table 9-19) with turbines. Turbines T1, T3, T9 and T14 are all located at the edge of conifer plantation. Bat species utilise the edge of conifer plantation for foraging and commuting and insect prey abundance is higher along linear woodland features and woodland edge habitat.

The assessment of the results of the static detector monitoring undertaken in 2022 also indicate the likely presence of a common pipistrelle roost site(s) in the vicinity of the detectors located at turbines T1, T3, T6, T8 and T13, with habitat connectivity leading to these locations. The second species with the highest activity is Soprano pipistrelle, followed by Leisler's bat. Based on the results, it is noted that there is likely a potential roost site for soprano pipistrelle and Leisler's bat species in the wider area, with commuting routes leading to the detector locations on the site. Soprano pipistrelle showed connectivity with commuting routes in the vicinity of all turbine locations, except for turbines T3 and T5. There is the potential for Leisler's roost(s) to be in the vicinity of turbines T1, T8 and T13.

Bat fatalities induced by wind turbine blade rotation are regularly described in Europe, as summarised by Rodrigues *et al* (2008)[6]. In addition, wind turbines may cause non-lethal impacts, such as disturbance of commuting and migration routes, displacement and local habitat loss. As summarised by Nature Scot (2021), wind farms can affect bats in the following ways:

- Collision mortality, barotrauma and other injuries (although it is important to consider these in the context of other forms of anthropogenic mortality)
- Loss or damage to commuting and foraging habitat, (wind farms may form barriers to commuting or seasonal movements, and can result in severance of foraging habitat);
- Loss of, or damage to, roosts;
- Displacement of individuals or populations (due to wind farm construction or because bats avoid the wind farm area).

In relation to the Proposed Development, there is potential for the increase in turbine dimensions to result in direct impacts on bats through collision with turbine blades and death through barotrauma. In the absence of mitigation, this would represent a long-term significant adverse impact at the local geographic scale.

No potential roosting features have been recorded within the study area, therefore there will be no direct impacts on roosting habitat. Indirect impacts to nearby roosts are considered unlikely due to the distance of potential roosts (1.1km at closest location).

9.4.3.2. Grid Connection Cabling Route

Amphibians

There are a number of wet depressions in the topography of the lands adjacent to the grid connection cabling route that provide suitable habitat for amphibians. Further, the Ecological Restoration and Enhancement Management Plan for the Permitted Development includes for the retention of sediment ponds as habitat for dragonfly, damselfly, other insects, birds and amphibians. In view of these factors, there will be no significant adverse effects on amphibians during the operational phase.

No potential significant adverse effects on biodiversity as a result of the operational phase of the proposed grid connection cabling have been identified.

9.5. Mitigation Measures and Monitoring

9.5.1. Construction Phase

9.5.1.1. Aquatic Ecology

All construction phase environmental controls, mitigations and conditions in the area of surface water protection will be implemented as set out in the existing consent. This relates specifically to controls on sources and pathways of potential sediment, concrete, and hydrocarbon loss from the wind farm and proposed grid connection cabling route during the construction phase and includes all controls on potential forestry felling related nutrient and sediment losses, as permitted.

Compared to that already permitted, the Proposed Development, the additional ~500m of cable laying required to connect to Ardderroo substation does not present likely significant effects on any identified aquatic receptors, but as a precautionary measure and to address any potential for cumulative impacts, specific mitigations are set out in Table 9-29, primarily in relation to prevention and/or control of potential sediment loss during construction.

Table 9-29: Additional Grid Connection Cabling Route – Construction Mitigation

Objective	Measure	Details of Mitigation
Prevention and control of sediment loss	Best Management Practice – Cable Trenching	All trenching works shall be undertaken using a procedure ensuring that only short sections of the trench (≤100m) are open at any time, with each section capable of being cut and refilled within a single workday to prevent unexpected rainfall causing wash-out. Any run-off water which gathers in an excavated trench must be collected and treated appropriately using Best Practice methods (e.g., silt bags, settlement systems) before being discharged. There will be no discharge of silt contaminated pump-out water directly to on-site drains. Freshly excavated spoil must be retained in an area over 10m away from any drain or watercourse until such time as the trench is refilled. Where ancillary onsite drains are crossed with underground ducting, the release of sediment over baseline conditions will be prevented using silt traps, check dams and/or bunds. These will be put in place on either side of the dry drain crossing location in advance of construction works.
Prevention and control of sediment loss	Best Management Practice – Drain crossing	Drains are currently piped beneath the existing access roads that form the proposed grid connection cabling route. The 6 no. existing drains will be clearly marked with stakes or paint. Trenching will proceed to either side and then beneath the existing pipe(s) without disturbance to the drainage water flow through them. Where pipe extensions are required in relation to road widening, these shall be pre-installed to carry any drain flow over the construction area, creating a dry working area Preferential flow pathways from the trench and/or road surface towards the entry or exit of each piped drain shall be temporarily blocked using sand bags or staked geotextile silt fencing whilst the works are occurring and removed once the road widening and trenching is complete and stabilised.

[6] Rodrigues, L., Bach, L., Dubourg-Savage, M.J., Goodwin, J., Harbusch, C., 2008. Guidelines for consideration of bats in wind farm projects. EUROBATS Publication Series No. 3. PNUE/EUROBATS Secrétariat, Bonn, Germany 60pp.

Objective	Measure	Details of Mitigation
Prevention and control of sediment loss	Best Management Practice – Culvert extension	The piped culvert extension and cable ducting on the unnamed Abhainn na nArd Doiriú tributary will be installed during a low flow period. The instream works area will be made dry using a temporary pipe extension that carries drain flow over the entire works area. The permanent extension will be laid at the same gradient as the existing culvert and shall be embedded at the downstream end a minimum of 30cm with appropriate scour protection, if necessary, in the form of cobble/gravel substates.
Prevention and control of sediment loss	Best Management Practice – Forestry Felling	The following Guidelines & Standards apply during felling operations: ▪ Forestry & Water Quality Guidelines (DAFM, 2000a) ▪ Forest Harvesting & the Environment Guidelines (DAFM, 2000b) ▪ Standards for Felling and Reafforestation (DAFM, 2019) The ECoW will ensure all felling related water quality protection guidelines and standards are complied with during the pre-commencement and felling phases. The ECoW will carry out daily visual checks of all measures employed to avoid or reduce impact of forestry residues, erosion, including inspections of temporary drainage infrastructure (e.g., drain crossings), silt control measures, extraction routes and log storage areas. A detailed and comprehensive pre-felling survey of the minor drainage channels within the proposed felling areas and their proposed access routes must be undertaken by the forestry harvesting Site Manager and the ECoW. This will identify all 'aquatic zones' and 'relevant watercourses' / drains (as specified in Felling Standards (DAFM (2019)). Areas of very wet ground ("hotspots") must also be marked as exclusion zones as these could become damaged by machine tracking and/or become preferential surface run-off conduits following the felling. **Water exclusion zones (Section 6.1 DAFM (2019)):** Before operations commence, identify a 10 m wide exclusion zone along the edge of aquatic zones and hotspots, and mark this clearly on a site map. Machine traffic and timber stacking are not permitted within these zones. Trees within the reach of the harvester arm should be felled by harvester and stacked 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 processing outside the exclusion zone. In all cases, fell trees away from a water feature. Remove brash from drains and in as much as possible from the felling site as per the original wind farm consent. **Silt & sediment control (Section 7 DAFM (2019)):** Prior to the commencement of operations, install silt traps within existing forest drains that connect with aquatic zones, either directly or indirect through other relevant watercourses. Silt traps should be staggered along the length of the drain, and not only at the lower reaches towards its outflow. Apply silt fences where necessary, to block pathway for silt in areas where overland flow is possible. Once silt traps and silt fences become functional, check regularly and maintain as necessary, in order to ensure continued effectiveness throughout operations. **Temporary water crossings (Section 8 DAFM (2019)):** Avoid crossing on-site forest drains / 'relevant watercourses' and aquatic zones. Direct crossing over stream beds is not permitted. Minimise the crossing of drains during felling and extraction and restrict machine activity to brashed extraction racks and haulage routes. Where a drain crossing is needed, select a method that prevents the breakdown and erosion of drain sides. Where necessary, deploy a heavy-duty plastic culvert lengthways into the channel and cover with brash material. The culvert must be correctly sized and overlaid with brash.
Overseeing of environmental controls	Monitoring during Construction	A suitably qualified Site Environmental Manager (SEM) acting as Ecological Clerk of Works (ECoW) and a Project Ecologist will be employed to oversee the construction phase, including any advance works period, to ensure compliance with methods, mitigation measures and monitoring set out in the existing consent, the Outline Construction and Environmental Management Plan (OCEMP) accompanying this amendment application and this document.

9.5.1.2.Amphibians

Spawning habitat for common frog was recorded in ditches present to the south of the road servicing Ardderroo substation and alongside the forestry road at the location of the proposed grid connection cabling. Frogs are active from spring to autumn. If works to clear any of the habitat features suitable to support common frog are to begin during the season where frogspawn or tadpoles may be present (February – mid-summer), a pre-

construction survey will be undertaken to determine whether breeding common frog are present. Any frog spawn, tadpoles, juvenile or adult frogs present will be captured and removed from affected habitat by hand net and translocated to the nearest area of available suitable habitat.

If the size or depth of the habitat feature is such that it cannot be determined whether all common frog have been captured, it will be drained under the supervision of a suitably experienced ecologist to confirm that no amphibian species remain before it is destroyed or infilled. Any mechanical pumps used to drain the habitat feature will have a screen fitted and be sited so that no amphibian species can be sucked into the pump mechanism.

Any capture and translocation works shall be undertaken immediately in advance of site clearance/construction works commencing.

9.5.1.3. Mammals

A pre-construction mammal survey will be undertaken for otter and badger within suitable habitats within the works areas associated with the Proposed Development. The survey will be undertaken to check for any changes in otter and badger and to ensure that these species have not taken up residence within or close to the development footprint.

9.5.1.4. Bats

Buffer Zone

To minimize risk to bat populations during forestry clearance, a buffer zone is required around any treeline, hedgerow, woodland feature, into which no part of the turbine should intrude.

According to Nature Scot (2021) guidance:

"The Eurobats guidance recommends a 200m buffer around woodland areas. There is, however, currently no scientific evidence to support this distance in the UK and it is recommended that a distance of 50m between turbine blade tip and nearest woodland (or other key habitat features such as wetlands etc.) is adequate mitigation in most, lower risk situations. Exceptionally, larger buffers may be appropriate, e.g. near major swarming and hibernation sites. The longevity of wind farms should also be taken into account and the maximum growth, or management, of woodland and other relevant habitat features considered in their planning."

These distances were taken into account during the design phase of the proposed amendments to the Proposed Development. The formula illustrated in Figure 9-7 was used to calculate the required felling buffer for each turbine. A felling buffer is required for conifer plantation located in the vicinity of turbines T1, T3, T9 and T14.

Calculate the distance between the edge of the feature and the centre of the tower (*b*) using the formula:

$$b = \sqrt{(50+bl)^2 - (hh - fh)^2}$$

where:

bl = blade length, *hh* = hub height ,
fh = feature height (all in metres).
For the example shown, *b* = 69.3m[14]

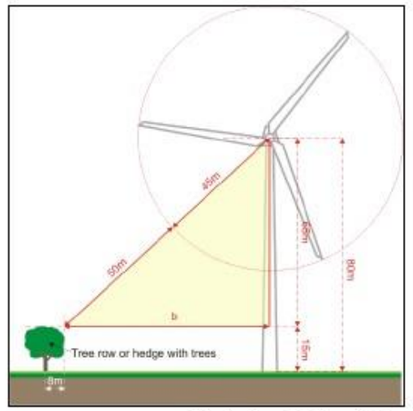

Illustration © Entec Ltd.

Figure 9.7 Estimating Buffer Distance (Nature Scot, 2021)

Existing trees will be cleared around turbines T1, T3, T9 and T14 to provide a vegetation-free buffer zone around each turbine. All buffers will be maintained throughout the lifetime of the wind farm.

In addition to the above mitigation by design, the following mitigation measures are proposed:

Lighting restrictions

In general, artificial light creates a barrier to bats so lighting should be avoided where possible. 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 construction lighting is required, lighting shall be directed away from all woodland and linear habitats to be retained. This can be achieved by the design of the luminaire and by using accessories such as hoods, cowls, louvers and shields to direct the light to the intended area only.

Ecological Restoration and Enhancement Management Plan

The Ecological Restoration and Enhancement Management Plan for the Permitted Development includes for the enhancement of keyhole felled areas. As stated in Section 3.2.7.2 of the Ecological Restoration and Enhancement Management Plan *"native broadleaved trees will be planted a minimum of 50m away from turbines to maintain the protective bat buffer"*. This requirement will be amended to exclude the planting of tree and scrub species within the felling buffer as defined in Figure 9-7.

Pre-construction Surveys

If two years lapse between the completion of bat activity surveys within the study area and commencement of construction, it will be necessary to repeat one season of surveys during the activity period. Future survey work will be completed according to best practice guidelines available (Collins, 2016; Nature Scot 2021 and any updates of these guidelines) and will include static detector, activity and roost inspection surveys. The results of these surveys will be used to refine mitigation measures as appropriate.

9.5.2. Operational Phase

9.5.2.1. Aquatic Ecology

All operation phase mitigations and conditions will be implemented as set out in the existing consent. This relates specifically to environmental controls on sources and pathways of potential sediment, concrete and hydrocarbon loss from the Proposed Development during the operation phase.

9.5.2.2. Bats

As detailed in Section 9.5.1.4, a buffer zone free of woodland/trees within 50m of turbine blade tips will be created during the construction phase. This requirement will mitigate potential impacts as a result of collision mortality during the operational phase.

Monitoring

A Bat Monitoring Plan will be prepared in accordance with Nature Scot (2021) guidelines. The aim of the monitoring will be to assess changes in bat activity patterns and the efficacy of mitigation. Monitoring should take place for at least 3 years after construction and shall include static detectors surveys, walked survey transects and corpse searching. A curtailment programme will be devised at end of Year 1, if necessary, around key activity periods / weather parameters. Effectiveness of mitigation / curtailment should be monitored and kept under review for 3 year period.

9.6. Residual Effects

9.6.1. Construction Phase

There is likely to be localized temporary disturbance in the form of intermittent periods of elevated turbidity in downstream watercourses during construction, but with all mitigations correctly implemented, including those permitted and those set out in Section 9.5 of this chapter and the accompanying OCEMP, there will be no likely or significant effects on downstream aquatic receptors during the construction phase. The residual impact will be slightly negative, short term, reversible locally with neutral impact on aquatic Qualifying Interests of the SAC further downstream.

Potential significant effects on bats have been identified as a result of habitat loss, loss of prey species and disturbance during the construction phase of the Proposed Development. In view of the relatively small quantity of habitat loss (c2.45ha of forestry) and the retention of forestry edge habitat for foraging and commuting, a negligible to slight long-term impact is expected.

Potential significant effects on spawning common frog have been identified on frog in the absence of seasonal mitigation during the construction of grid connection cabling to the south of the road servicing Ardderroo substation. With the implementation of mitigation, no significant residual impacts are expected.

9.6.2. Operational Phase

Once the infrastructure is in place and the access roads, hardstandings and drainage have stabilised, for example regrowth of vegetation in on-site drainage swales, there are no likely or significant effects on downstream aquatic receptors predicted during the operation phase.

Potential significant adverse effects on bats have been identified as a result of collision with turbine blades and death through barotrauma. Taking into consideration the proposed mitigation measures within this EIAR and the requirement for post construction bat surveys for the Permitted Development, significant residual effects on bats with regard to habitat loss/degradation, disturbance/displacement or mortality are not expected.

9.6.3. Decommissioning Phase

No new impacts will arise on biodiversity during the decommissioning phase of the project.

9.7. Cumulative Effects

In accordance with CIEEM (2018), cumulative impacts and effects from two or more developments may be:

- Additive/incremental – multiple activities/projects (each with potentially insignificant effects) added together to give rise to a significant effect due to their proximity in time and space. The effect may be additive (1+1 = 2) or synergistic (1+1 = 3).
- Associated/connected – a development activity enables another development activity e.g. phased development as part of separate planning applications. Associated developments may include different aspects of the project which may be authorised under different consent processes.

Details on projects considered in this assessment are provided in Section 1.10 of this EIAR (Section 1 Introduction).

9.7.1. Other Wind Farm Developments

9.7.1.1. Ardderroo Wind Farm (27m from the Proposed Development)

The primary land use in the area is commercial forestry. The remainder of the site was occupied by marginal farmland and peatland habitats. Areas of active lowland blanket bog were found to correspond to the E.U. Habitats Directive Annex I priority habitat Active Blanket Bog [7130* priority). Depressions in the peatland areas correspond to the Annex I habitat Depressions of peat substrates of the Rhyncosporion (Natura 2000 code 7150). Lakes recorded correspond to Oligotrophic waters containing very few minerals of sandy plains Littorelletalia uniflorae (Natura 2000 code 3110) and Natural dystrophic lakes and ponds (Natura 2000 Code 3160); and wet heath was found to correspond with Atlantic Wet Heaths with *Erica tetralix* (Natura 2000 code 4010).

The following bat species were identified during the dedicated bat surveys undertaken at the Ardderroo site: Common Pipistrelle, Soprano Pipistrelle, Unidentified Pipistrelle, Leisler's Bat, *Myotis* spp., Brown Long-eared Bat, Lesser Horseshoe Bat and Nathusius' Pipistrelle, including a minor roost at Letter Lodge Outhouse.

Significant negative residual effects were not identified with regard to any ecological receptor.

9.7.1.2. Galway Wind Park Cloosh (4.3km west) (overall 69 turbines consented and 60 constructed)

The wind farm site is dominated by commercial forestry plantation. The lakes and small ponds in the study area were found to correspond to the Annex I habitats (3130) and (3160).

Evidence of badger and Pine Marten was recorded, and otter spraint was recorded at Seecon Lough along with an identified holt. Evidence was also recorded from Loughaunayella.

The only bat species recorded within the development site was Common Pipistrelle.

Fish sampling was not conducted for this development but results from IFI fish sampling in 2007/2008 were utilised to inform the impact assessment. The results revealed the absence of Atlantic salmon from the western main stem of the Owenboliska River.

Significant negative residual effects were not identified with regard to any ecological receptor.

9.7.1.3. Galway Wind Park Uggool (2.6km northwest)

Active Blanket Bog Wet Heath habitat were noted to occur within the site (Annex I habitat 7130).

No evidence of Otter was recorded. Common Pipistrelle was the only species of bat recorded.

Significant negative residual effects were not identified with regard to any ecological receptor.

9.7.1.4. Galway Wind Park Seecon (5.2km southwest)

The development site is dominated by commercial forestry plantation, with acid oligotrophic lakes also present.

Evidence of Pine Marten and badger was recorded within the site and otter spraint was recorded at the edge of bog and forestry to the east of the site and it recognised that the species occurs in the wider area.

Three species of bats were recorded: Common Pipistrelle, Soprano Pipistrelle and Daubenton's bat.

Kerry slug was recorded within conifer plantation.

Significant negative residual effects were not identified with regard to any ecological receptor.

9.7.1.5. Lettercraffroe (7.3km northwest)

The predominant habitat within the wind farm site was coniferous plantation. Habitats of ecological significance identified included Wet Heath, Dystropic Lake, Upland Blanket Bog and Transition Mire and Quaking Bog. The Transition Mire and Quaking bog were found to have viable characteristics of Annex I habitats.

Bat species recorded included Common Pipistrelle, Soprano Pipistrelle and Daubenton's Bat.

Potential habitat for Pine marten and red squirrel is present. Otter was not recorded however the presence of suitable habitat in Loughs at the north of the site was noted.

Kerry slug was recorded within the site.

Significant negative residual effects were not identified with regard to any ecological receptor.

9.7.1.6. Knockalough Wind Farm (3km south)

The site is dominated by conifer plantation, with one habitat of ecological significance noted- Dystrophic Lakes.

No evidence of badger or otter was recorded; however it was noted that otter may visit the lakes at the site. Suitable habitat for Pine marten was present.

Significant negative residual effects were not identified with regard to any ecological receptor.

9.7.1.7. Leitir Gungaid (Lettergunnet) (6.9km south-southeast)

Habitats of conservation value recorded at the site include blanket bog, wet heath, dry siliceous heath, dystropic lakes and oligotrophic lakes; the rest of the site comprises modified habitats (cutover bog and conifer plantation).

No mammals of conservation concern were recorded, however it was noted that suitable habitat for otter is present at the site.

No bats were recorded at the site.

Significant negative residual effects were not identified with regard to any ecological receptor.

9.7.1.8. Letterpeck (Shannagurran & Truskaunngappul) (5.3km south)

The site is dominated by cutover bog, with Annex I habitats lowland blanket bog and a dystrophic pond also present.

Evidence badger was recorded at the site. No otter was recorded within the site, however evidence of this species was recorded outside of the site boundary.

No bats were recorded at the proposed site.

Significant negative residual effects were not identified with regard to any ecological receptor.

9.7.2. Other Projects (non-wind farm)

Other notable projects include the proposed N59 Maigh Cuilinn (Moycullen) Bypass Road Project, currently under construction, and the Connemara Greenway, which received permission from An Bord Pleanála in 2013. No potential for significant cumulative impacts with these projects has been identified.

Selected Domestic / Agricultural Projects within 2.5km[7]

Other small-scale projects include planning permission for the erection of dwelling house and garage (Pl. Ref: 211486), located 2.25km south; planning permission for the construction of new storage shed and all associated ancillary concrete works (Pl. Ref: 212041), located 1.5km south; planning permission for a dwelling house and garage (Pl. Ref: 211811), and planning permission for a domestic shed (Pl. Ref: 181382), located 2.3km to south. No potential for significant cumulative impacts with these projects has been identified.

Other activities in the area of the Proposed Development include felling operations, which include a Coillte felling programme in operation in the area. Coillte also propose to fell forestry within the Ardderroo Wind Farm boundary as part of a bog restoration plan, subject to licensing. Felling operations are subject to Appropriate Assessment and are required to be undertaken in accordance with Standards for Felling and Reforestation (DAFM, 2019). No potential for significant cumulative impacts with these projects has been identified.

[7] Based on a review of Galway County Council's Planning Enquiry system, as accessed on 14th April 2023.

9.7.3. Assessment of Cumulative Effects

No potentially significant residual ecological effects were reported for any ecological features within any of the nearby windfarm or other projects reviewed. It is noted that 60 of the permitted 69 turbines at Galway Wind Park (GWP) have been constructed. Any further development at GWP will be subject to mitigation and pollution control measures conditioned as part of the Permitted Development.

Following mitigation, no potentially significant effects on any of the ecological features has been identified with regard to the Proposed Development at Knockranny. The current proposal will not result in any net loss of ecologically significant habitat. It will not result in significant disturbance or displacement of faunal species within the site and surrounding lands.

Taking into consideration the reported residual effects from other plans and projects in the area and the predicted residual effects of the Proposed Development at Knockranny, no residual cumulative and/or in combination effects have been identified with regard to ecological features either in isolation or cumulatively with other projects.

The Proposed Development is not likely to result in any cumulative effects on biodiversity with other existing, permitted or proposed developments during the decommissioning phase.

9.8. Difficulties Encountered in Compiling Information

No difficulties were encountered in compiling the information contained in this assessment.

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- Wyse Jackson, M., FitzPatrick, Ú., Cole, E., Jebb, M., McFerran, D., Sheehy Skeffington, M. and Wright, M. (2016) Ireland Red List No. 10: Vascular Plants. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Dublin, Ireland.

CNOC RAITHNÍ (KNOCKRANNY) WIND FARM

CHAPTER 10

Ornithology

CHAPTER 10 - Ornithology

Contents

Chapter 10

10. ORNITHOLOGY

10.1. Introduction

This chapter provides the Ecological Impact Assessment in relation to the Proposed Development in respect of avifauna.

This chapter outlines the ornithological interest of the receiving environment within the planning application area and within a wider Zone of Influence (ZoI) in the vicinity of the Proposed Development site. It comprises information as required by Annex IV to the EIA Directive to be contained in an EIA Report (EIAR), in respect of avifauna. Particular regard has been paid to species of ornithological importance. These include species with national and international protection under the Wildlife Acts (as amended) and the EU Birds Directive2009/147/EC among other relevant legislation (as detailed below). Where potential significant effects are identified, mitigation is prescribed and residual impacts on avian receptors are assessed.

A full description of the Proposed Development is provided in Chapter 2 of this EIAR.

10.2. Assessment Methodology

10.2.1. Guidelines

Scottish Natural Heritage (SNH) (now known as NatureScot)[1] is the public body in Scotland tasked with promoting and caring for the country's natural heritage[2]. Owing to the lack of industry guidelines on bird survey requirements for development sites in Ireland, SNH is regarded as the "industry standard" typically cited by NPWS and planning authorities in Ireland as it is the most detailed guidance document available. SNH has produced several guidance documents concerning birds and impact assessment of proposed development sites (as referenced below), the most recent of which was produced in March 2017, '*Recommended bird survey methods to inform impact assessment of onshore wind farms*'. As outlined in the guidance, the purpose of the document is to define a set of standards for bird surveys at proposed onshore wind farm sites in Scotland.

While many parallels can be drawn between Scotland and Ireland regarding the landscape, habitats, and species, there are also differences which mean that in some instances modifications to survey design may be required to ensure that bird surveys are relevant in an Irish context. While some aspects of the SNH guidelines are easily transferable to an Irish scenario, e.g., area to be surveyed or survey duration, other aspects such as determining target species and distribution and abundance surveys can require some degree of modification to ensure relevance and maintain applicability in an Irish context. In other instances, SNH recommended surveys may not be applicable at all e.g., breeding surveys for species such as black grouse (*Tetrao tetrix*) and capercaillie (*Tetrao urogallus*), neither of which occur in Ireland. Therefore, some degree of interpretation is required when using SNH guidance in an Irish context.

The assessment had regard to the following guidelines produced by Scottish Natural Heritage:

- SNH (2017). Recommended bird survey methods to inform impact assessment of onshore wind farms. Scottish Natural Heritage.
- SNH (2018) Avoidance rate information & guidance note: Use of avoidance rates in the SNH wind farm collision risk model. Scottish Natural Heritage, Edinburgh, UK. Wind farm impacts on birds - Use of Avoidance Rates in the NatureScot Wind Farm Collision Risk Model | NatureScot [accessed 20th April 2023].
- SNH (2016). Assessing Connectivity with Special Protection Areas (SPAs). Scottish Natural Heritage.
- SNH (2012). Assessing the Cumulative Impact of Onshore Wind Energy Developments. Scottish Natural Heritage.
- SNH (2006). Assessing Significance of Impacts from Onshore Windfarms on Birds Outwith Designated Sites. Scottish Natural Heritage.
- SNH (2009). Monitoring the impact of onshore wind farms on birds. Scottish Natural Heritage.
- SNH (2000). Wind farms and birds: calculating a theoretical collision risk assuming no avoidance action. SNH Guidance Note.

The following Irish Guidance documents were consulted:

- Percival, S.M. (2003). Birds and wind farms in Ireland: A review of potential issues and impact assessment. Ecological Consulting.
- McGuinness, D., Muldoon, C., Tierney, N., Cummins, S., Murray, A., Egan, S. & Crowe, O. (2015). Bird Sensitivity Mapping for Wind Energy Developments and Associated Infrastructure in the Republic of Ireland. Guidance Document. Birdwatch Ireland.

The assessment also had regard to the following guidelines:

- CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester;
- DoEHLG (2010) Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities. Department of the Environment, Heritage and Local Government;
- European Communities (2000) Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC, Office for Official Publications of the European Communities, Luxembourg. European Commission;
- EC (2021) European Commission Notice Brussels C(2021) 6913 final 'Assessment of plans and projects in relation to Natura 2000 sites - Methodological guidance on Article 6(3) and (4) of the Habitats Directive 92/43/EEC;
- EC (2007) Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC – Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the commission. European Commission;

[1] All Scottish Natural Heritage (SNH) documents consulted for this report were published prior to the organisation's rebrand to NatureScot in August 2020. To avoid confusion, the organisation and its documents remain referenced as SNH throughout this report.

[2] NatureScot accessed 20th April 2023

- European Commission (2011). Wind energy development and Natura 2000. Guidance document;
- EPA (2022) Guidelines on the information to be contained in Environmental Impact Assessment Reports. Draft. Environmental Protection Agency;
- NRA (2008) Environmental Impact Assessment of National Road Schemes – A Practical Guide Rev. 1. National Roads Authority;
- NRA (2009) Guidelines for the Assessment of Ecological Impacts of National Road Schemes Rev. 2. National Roads Authority;
- NRA (2008) NRA Guidelines on Ecological Surveying Techniques for Protected Flora and Fauna on National Road Schemes. National Roads Authority;
- NRA Various Environmental Assessment and Construction Guidelines (both adopted and draft versions).

Studies were also carried out in accordance with the following legislation:

- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive) and Directive 2009/147/EC (codified version of Directive (79/409/EEC as amended (Birds Directive)) – transposed into Irish law as European Communities (Birds and Natural Habitats) Regulations 2011;
- European Communities (Environmental Impact Assessment) Regulations, 1989 to 2006;
- European Communities (Environmental Liability) Regulations, 2008 (S.I. No. 547 of 2008);
- Planning and Development Act, 2000 (as amended); and
- Wildlife Act 1976, as amended.

10.2.2. Desk Study

Sources of published material that were consulted as part of the desk study for the purposes of the ecological impact assessment are as follows:

- Ornithology Chapter of the EIS completed for the Permitted Development.
- National Parks & Wildlife Service (NPWS) natural heritage database for designated areas of ecological interest and sites of nature conservation importance within the study area and it's Zone of Influence;
- EIAR Biodiversity chapters for nearby development (accessed via EIA Portal and Galway County Council Map viewer);
- Birdwatch Ireland – Bird Sensitivity to Wind Energy mapping (accessed via NBDC);
- Review of Ordnance Survey maps and ortho-photography;
- Review of the National Biodiversity Data Centre (NBDC) database for records of rare and protected species within the 10km OS Grid Square the subject site is situated in;
- Review of specially requested records from the NPWS Rare and Protected Species Database;
- Review of (Gilbert et al. 2021) Birds of Conservation Concern in Ireland 2020-2026;
- Review of BirdWatch Ireland, Bird Atlas 2007 - 2011, National Biodiversity Data Centre, Ireland[3];
- Review of BirdWatch Ireland I-WeBS (Irish Wetland Bird Surveys) site information;
- General ornithological information available from BirdWatch Ireland (www.birdwatchireland.ie);
- Irish Bird Reports and the journal Irish Birds, published by BirdWatch Ireland;
- Review of the 2015 National Survey of Breeding Hen Harrier in Ireland Report (Ruddock et al. 2016);
- Other information sources and reports footnoted throughout the report;
- Aerial Photography; and
- 1:50,000 Ordnance Survey (OS) Map; Discovery Series.

10.2.3. Consultation

Consultation with prescribed bodies was undertaken as described in Chapter 1, Section 1.4. No responses in relation to ornithology have been received to date.

10.2.4. Criteria for Identifying Target Species

The results of the desk-top study were used to identify those bird species which were considered likely to occur in the area. These target species formed the main focus of the bird surveys undertaken.

With regards to drawing up the target species list for Cnoc Raithní Wind Farm, the SNH guidance document '*Recommended bird survey methods to inform impact assessment of onshore windfarms*' (SNH, 2017) was referred to when drawing up the target species list for the proposed development. Additionally, Special Conservation Interest (SCI) species for SPAs located within a 20 km radius of the site were considered using guidelines provided by SNH 'Assessing Connectivity with Special Protection Areas (SPA)' (SNH, 2016) to assess the core foraging distances of certain species and potential connectivity between the site and SPAs. In conjunction with the findings of the desk-top study, the target species list was drawn from the following.

In relation to the proposed development site, the target species list was drawn from:

- Annex I of the Birds Directive (2009/147/EC)
- Fourth Schedule species protected under the Wildlife Acts (as amended) (Buzzards, eagles, falcons, harriers, hawks, kites, osprey, owls[4])
- Red-listed Species of Conservation Concern in Ireland (BoCCI) 2020-2026 (Gilbert et al., 2021).

As outlined above and as set out in SNH (2017), target species typically comprise those species which are afforded a higher level of legislative protection and should be restricted to those likely to be affected by wind farms. Therefore, only red-listed species have been included as target species, unless the species meets one of the other target species selection criteria as outlined above e.g., Annex I. However, to ensure other species which may potentially be sensitive to wind farms were not missed during surveys, all other species of gull, wader, duck, diver, goose, swan, cormorant, and heron were included as secondary species. It is generally considered that passerine species are not significantly impacted by wind farms (SNH, 2017); however, their presence was recorded to provide a complete picture of bird usage of the site.

[3] https://maps.biodiversityireland.ie/Dataset/220 (accessed 05 April 2023)

[4] http://www.irishstatutebook.ie/eli/1976/act/39/schedule/4/enacted/en/html

10.2.5. Field Survey

Initial reconnaissance walkovers of the site were carried out to assist in determining the scope and extent of the surveys. Field surveys were undertaken to gather detailed information on bird distribution and flight activity to predict the potential effects of the wind farm proposal on birds. All surveys were carried out in accordance with SNH Guidance (2017).

The field surveys comprised two main elements: vantage point (VP) surveys to gather flight data for target species, and targeted distribution and abundance surveys undertaken to gain an understanding of the bird species occurring in the area which may be subject to impacts from the development.

The targeted distribution and abundance surveys comprised the following elements:

- Hinterland surveys
- Waterbird count surveys
- Walkover surveys
- Hen Harrier (*Circus cyaneus*) surveys

10.2.5.1. Vantage Point Surveys

Vantage point (VP) surveys were carried out by suitably qualified personnel on a monthly basis, as detailed in Appendix 10.1. The overall aim of these surveys was to quantify the level of target species flight activity within the flight activity survey area. The flight activity survey area was taken to be that area encompassing the potential development area, extending out to a distance of 500m beyond the development boundary.

Selection of VP Locations

Ideally, vantage points are located on elevated areas, or other areas, which provide clear views over the study area. Achieving maximum visibility over as much of the site as possible is important for these surveys.

In order to minimise observer effect on bird behaviour, VPs should ideally be located outside the survey area but should be located as close to the site as possible. SNH (2017) stipulates that if VPs are located within the study area, VP surveys should not be carried out simultaneously with other VPs which overlook them to minimise potential observer effect on birds.

Four VP locations were selected for coverage of the proposed Wind Farm Site (using the initial survey area red line boundary issued to MWP by the client) and were surveyed over all seasons. The location of the VP's, using the Irish Transverse Mercator (ITM) coordinate system, is provided in Table 10-1. Each VP is to be watched for a total of six hours per month during the winter and summer periods. The watches are divided into three-hour periods for each individual watch.

Table 10-1: Vantage Point Locations at the Proposed Development

VP No.	ITM
1	514977, 735775
2	516240, 234088
3	515833, 733017
4	514249, 734207

Viewshed Analysis of VPs

According to SNH (2017), vantage point viewsheds should extend to 2 km. Viewshed analysis was undertaken for each VP location to determine visual coverage of the survey area. Viewsheds were set to observer height of 2m and encompassed a 2 km radius with 360° views, the full extent of which can be readily viewed using a telescope. Each viewshed was then cropped to a 180° arc showing the relevant direction of view. 100% of the wind farm site was encompassed within the VP viewsheds.

Viewsheds from each VP showing the extent of site coverage are provided in Figure 10-1 below.

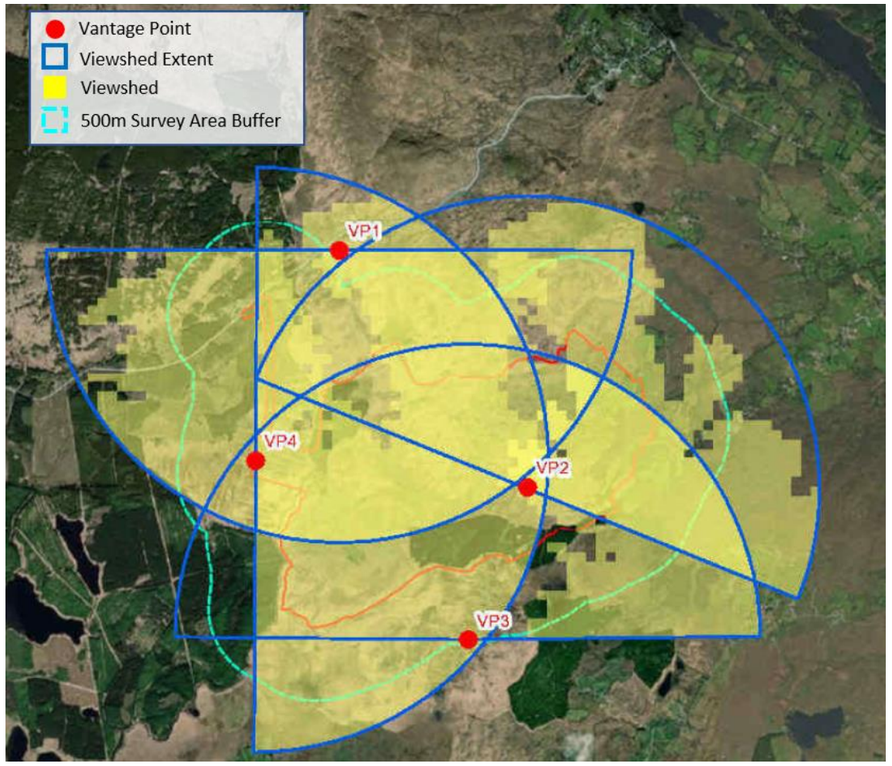

Figure 10.1 Viewsheds of the Site from each VP

Recording of Flight Data

During VP surveys the flight behaviour of target species was recorded. Behaviour of secondary species was also recorded; however, the recording of secondary species was subsidiary to recording of target species (SNH, 2017).

At the time of each species observation the following information was recorded:

- The time at which the bird was first detected

- The flight duration (seconds) within various flight height categories (0-20m, 20-50m, 50-100m, 100-180m and >180m)
- Sex and age of the bird(s) (adult/juvenile), where possible to determine
- Type of activity/behaviour such as hunting, flying, displaying etc.
- Estimation of actual flight height
- Habitat(s) in which the bird was observed
- Weather conditions at the time of sighting including wind speed and direction, and degree of visibility.

Once an initial sighting was made, each target or secondary species was observed until lost from view. Flight paths were recorded as observed, including where birds travelled or were observed outside of the flight activity survey area; such that all flight activity within the broader landscape was encompassed.

Recording of Other Species

During the VP surveys, counts of non-target/secondary species were also recorded where recording did not infringe on recording of target/secondary species flight data.

10.2.5.2. Distribution and Abundance Surveys

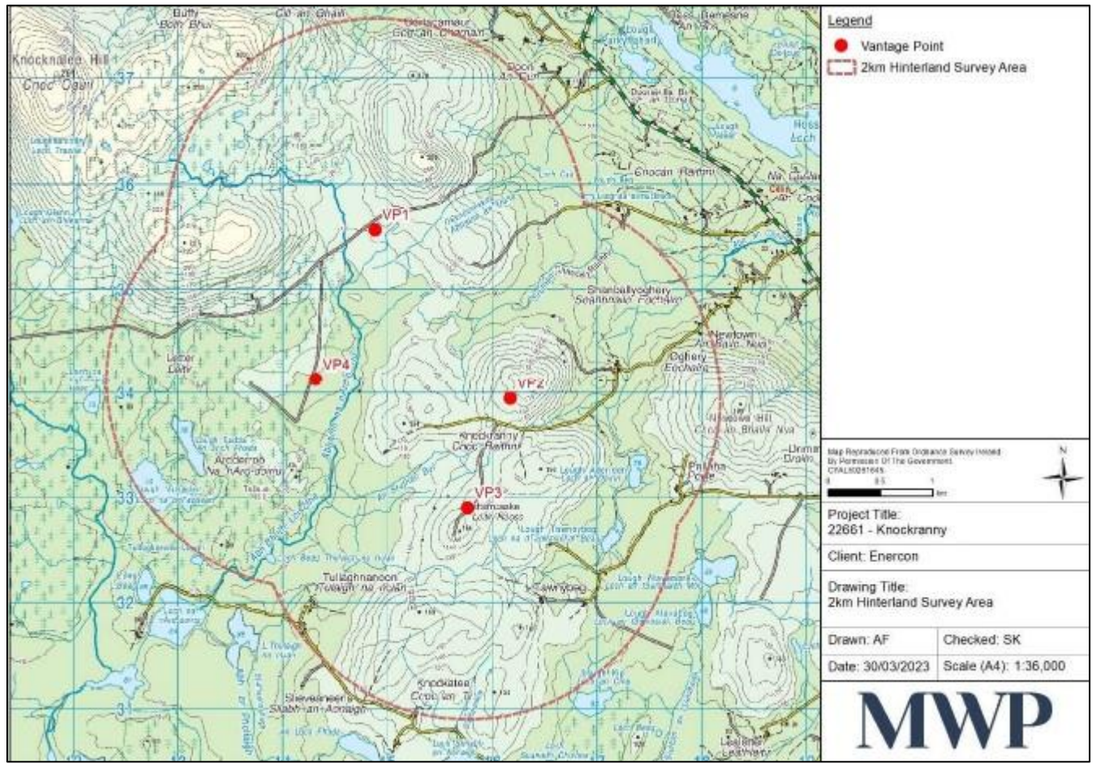

Figure 10.2 The 2 km buffer area used during the distribution and abundance surveys

Hinterland Surveys

The hinterland surveys were carried out using a combination of driven and walked surveys within a 2 km buffer area surrounding the proposed development site (see Figure 10-2, above). The surveyor regularly stopped to record all bird species encountered and walked habitats deemed suitable for target species. The walked route gave representative cover of the habitats in the study site. The purpose of the counts was to gain a better understanding of the birds using habitats surrounding the site, and of those which may or may not traverse the site.

Waterbird Count Surveys

Waterbird counts were conducted in accordance with Birdwatch Ireland I-WeBS survey guidelines. Target species for this survey included all species of waterbird. Lakes and other waterbodies within 2 km of the site were surveyed (see Figure 10-2 above). The number of target species seen or heard at each survey location was recorded.

Counts were carried out when visibility and weather conditions were most favourable.

Walkover Surveys

Walkovers of the proposed development site were carried out throughout the survey period to assess the presence and abundance of target species and secondary species using the area. The walkover method is utilised to cover large areas of ground efficiently and effectively within the site boundary (as illustrated in Figure 10-1). The surveyors followed routes through the site searching for signs of target species and counting any birds that are sighted. The route gave representative coverage of all suitable habitats such as wooded areas, waterbodies, wetlands, heath, crags and grassland.

Hen Harrier Survey

The following methods were carried out ensuring minimal disturbance to hen harrier:

Winter season: Roost sites within 2 km of the proposed windfarm site are to be identified and surveyed. Roosts were identified by following hen harriers in the late afternoon to their roost sites. During the winter season, hen harriers are known to roost communally in tall ground vegetation upon which they build roosting platforms. Roost surveys are carried out at dusk at known roost sites to count hen harriers. This survey commenced 1.5 hours before sunset and continued until 30 minutes after sunset, or until it was too dark to see. Roost surveys disturb breeding birds and are not recommended during the breeding season.

Breeding season: Hen harriers are most detectable between March and May before egg laying, and in late June to July after the young have fledged. Two visits to the site are recommended, and if hen harrier are sighted, an additional two visits are recommended. A walkover method was used to locate suitable hen harrier habitat and sightings of hen harrier were recorded, and any signs (such as remains of kills, faecal droppings and plucking sites) of hen harrier presence were recorded.

Evidence of breeding includes food passes between two adults, an adult carrying prey, and sightings of recent fledglings.

10.2.6. Impact Assessment

The information gathered from desk study and survey has been used to prepare an ecological impact assessment (EcIA) of the Proposed Development upon the identified ecological features. The EcIA has been undertaken following the methodology set out in EPA (2022) (see Chapter 1 for further details) and CIEEM (2018) and with reference to BS 42020:2013. EcIA is based upon a source-pathway-receptor model, where the source is defined as the individual elements of the Proposed Development that have the potential to affect identified ecological

features. The pathway is defined as the means or route by which a source can affect the ecological features. An ecological feature is defined as the feature of interest, being a species, habitat or ecologically functioning unit of natural heritage importance. Each element can exist independently however an effect is created where there is a linkage between the source, pathway and feature.

A significant effect is defined in CIEEM (2018) as:

"*an effect that either supports or undermines biodiversity conservation objectives for 'important ecological features'…. or for biodiversity in general*."

BS 42020:2013 states that if an effect is sufficiently important to be given weight in the planning balance or to warrant the imposition of a planning condition, e.g. to provide or guarantee necessary mitigation measures, it is likely to be "significant" in that context at the level under consideration. The converse is also true: insignificant effects would not warrant a refusal of permission or the imposition of conditions.

Likely significant effects are predicted on the basis of the Proposed Development as set out in Chapter 2 of this EIAR.

Avifauna were initially evaluated as to whether or not they constitute ecological features for assessment following NRA guidance as outlined in Table 9-4 of Chapter 9: Biodiversity. For the purposes of impact assessment, the importance value, or sensitivity, assigned to an avian ecological receptor following published guidance as in Percival (2003) and SNH (2017) and literature review of published information on birds (as listed in the bibliography). Table 10-2 details the combined ecological feature evaluation criteria used to assign sensitivity levels to avian ecological features.

Table 10-2: Ecological Evaluation Criteria (Sensitivity) for Avifauna (adapted from Percival, 2003 and NRA, 2009)

Sensitivity	Combined Criteria from Percival (2003) and NRA
Very High	Species is cited interest of SPA. Species present in Internationally important numbers. Resident or regularly occurring populations (assessed to be important at the national level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive
High	Other non-cited species which contribute to integrity of SPA. Ecologically sensitive species including the following: divers, common scoter, hen harrier, golden eagle, red-necked phalarope, roseate tern and chough. Species listed on Annex 1 of the EU Birds Directive. Regularly occurring relevant migratory species which are rare or vulnerable. Resident or regularly occurring populations (assessed to be important at the national level) of the following: Species protected under the Wildlife Acts; and/or Species listed on the relevant BoCCI Red list.
Medium	Species present in regionally important numbers (>1% of regional population). Species occurring within SPA's but not crucial to the integrity of the site. Resident or regularly occurring populations (assessed to be important at the County level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; County important populations of species. Species that are rare or are undergoing a decline in quality or extent at a national level.
Low	Locally important populations of priority species identified in the Local BAP, if this has been prepared; Resident or regularly occurring populations (assessed to be important at the Local level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Amber listed species on the BoCCI.

Effects on avifauna are assessed following published guidance by Percival (2003). Once key avian receptors have been selected and assigned an evaluation of importance or sensitivity, the significance of potential effects are rated as a product of both the magnitude of the predicted effect and the sensitivity of the key receptor affected. The magnitude of effect is based on probability of the likely effect occurring.

The criteria outlined in Table 10-3 below has been developed by Percival (2003) to determine the magnitude of potential effects on a species. Methodology for assessing sites outside of European Sites (i.e. SPAs) state '*the test of significance of an impact will be whether the wind farm impact is causing a significant change to the population its range or distribution*' (Percival, 2003).

Table 10-3: Determination of Magnitude of Effects (Percival, 2003)

Magnitude	Description
Very High	Total loss or very major alteration to key elements/ features of the baseline conditions such that the post development character/ composition/ attributes will be fundamentally changed and may be lost from the site altogether. Guide: < 20% of population / habitat remains
High	Major loss or major alteration to key elements/ features of the baseline (pre-development) conditions such that post development character/ composition/ attributes will be fundamentally changed. Guide: 20-80% of population/ habitat lost
Medium	Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition/attributes of baseline will be partially changed. Guide: 5-20% of population/ habitat lost
Low	Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline condition will be similar to pre-development circumstances/patterns. Guide: 1-5% of population/ habitat lost
Negligible	Very slight change from baseline condition. Change barely distinguishable, approximating to the "no change" situation. Guide: < 1% population/ habitat lost

The significance of potential effects is assessed by cross tabulating the magnitude of effects and bird sensitivity to predict significance of each potential effect. Population status, distribution and trends of potentially affected species such as migratory winter birds are taken into consideration when undertaking the assessment.

Significant ratings are interpreted as follows, very low and low should not normally be of concern however normal design care should be undertaken to minimise effects, medium represents a potentially significant effect that

requires careful individual assessment, while very high and high represents a highly significant effect on bird populations. A significance matrix table, combining magnitude and sensitivity to assess overall significance is presented in Table 10-4.

Table 10-4: Significance Matrix (Percival, 2003)

Significance		Sensitivity			
		Very High	High	Medium	Low
Magnitude	Very High	Very High	Very High	High	Medium
	High	Very High	Very High	Medium	Low
	Medium	Very High	High	Low	Low
	Low	Medium	Low	Low	Low
	Negligible	Low	Low	Low	Very Low

10.2.6.1. Potential Collision Height

Two candidate turbine types are being considered, as detailed in Table 10-5. The proposed turbines will have a hub height of 81m or 82m. The swept height, or potential collision height is calculated from height of the hub minus and plus the rotor radius (Table 10-5).

Table 10-5: Candidate turbine types and calculation of potential collision height

Candidate Turbine	Rotor Radius (m)	Tip Height (m)	Hub Height (m)	Swept Height (m)
Vestas V136	68	150	82	14-150
Enercon 138	69	150	81	12-150

10.3. Baseline Conditions

10.3.1. Natura 2000 Designated Sites

10.3.1.1. Special Protection Areas (SPAs)

The European Union Directive on the Conservation of Wild Birds, known as the Birds Directive (Directive 2009/147/EC) requires Member States to designate legally protected areas for the conservation of endangered or migratory species of bird, as listed on Annex I of the Directive. These areas are known as Special Protection Areas (SPAs) and, since 1994, all SPAs form part of the Natura 2000 network of protected sites. The EU Birds Directive is implemented in Irish law under the European Communities (Birds and Natural Habitats) Regulations 2011.

An on-line search for SPAs within 20 km of the proposal site was carried out to identify any potential 'connectivity' between the site and SPAs, and to assess whether pathways exist through which the proposal could impact on the qualifying interest species, as recommended in the guidance document '*Assessing Connectivity with Special Protection Areas (SPAs)*' (SNH, 2016). Within this Scottish Natural Heritage (SNH) guidance document, core foraging ranges from nest-sites and roost-sites are published for both the breeding and winter seasons for the bird species frequently encountered when considering subject site development proposals. SNH recommends that typically the core foraging range should be used when determining whether there is connectivity between the proposed development and qualifying interest species.

An on-line search determined that there are three SPAs within 20 km of the site, as outlined in Table 10-6 and Figure 10-3 below.

A Natura Impact Statement for the Proposed Development, prepared in accordance with the requirements of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011) as amended and the Planning and Development Act (as amended), is presented separately to this EIAR and also accompanies this planning application.

Table 10-6: SPAs within 20km of the Proposed Development

Site Name and Code	Qualifying Interests	Distance from Proposed Development (km)[5]	Connectivity
Lough Corrib SPA (004042)	Gadwall (*Anas strepera*) [A051] Shoveler (*Anas clypeata*) [A056] Pochard (*Aythya ferina*) [A059] Tufted Duck (*Aythya fuligula*) [A061] Common Scoter (*Melanitta nigra*) [A065] Hen Harrier (*Circus cyaneus*) [A082] Coot (*Fulica atra)* [A125] Golden Plover (*Pluvialis apricaria*) [A140] Black-headed Gull (*Chroicocephalus ridibundus*) [A179] Common Gull (*Larus canus*) [A182] Common Tern (*Sterna hirundo*) [A193] Arctic Tern (*Sterna paradisaea*) [A194]	7.4km	Remote indirect connectivity via an unnamed stream at the east of the site, which flows into Ross Lake and Woods SAC c.4.8km downstream and, in turn, flows into Lough Corrib SPA a further 5.8km downstream (i.e. a total of 10.6km downstream of the site).

[5] Straight line distance from site boundary

	Greenland White-fronted Goose (*Anser albifrons flavirostris*) [A395] Wetland and Waterbirds [A999]		
Inner Galway Bay SPA (004031)	Black-throated Diver (*Gavia arctica*) [A002] Great Northern Diver (*Gavia immer*) [A003] Cormorant (*Phalacrocorax carbo*) [A017] Grey Heron (*Ardea cinerea*) [A028] Light-bellied Brent Goose (*Branta bernicla hrota*) [A046] Wigeon (*Anas penelope*) [A050] Teal (*Anas crecca*) [A052] Red-breasted Merganser (*Mergus serrator*) [A069] Ringed Plover (*Charadrius hiaticula*) [A137] Golden Plover (*Pluvialis apricaria*) [A140] Lapwing (*Vanellus vanellus*) [A142] Dunlin (*Calidris alpina*) [A149] Bar-tailed Godwit (*Limosa lapponica*) [A157] Curlew (*Numenius arquata*) [A160] Redshank (*Tringa totanus*) [A162] Turnstone (*Arenaria interpres*) [A169] Black-headed Gull (*Chroicocephalus ridibundus*) [A179] Common Gull (*Larus canus*) [A182] Sandwich Tern (*Sterna sandvicensis*) [A191] Common Tern (*Sterna hirundo*) [A193] Wetland and Waterbirds [A999]	13.1km	Tenuous remote and indirect connectivity via an unnamed stream at the east of the site, which flows into Ross Lake and Woods SAC Lough Corrib SAC before ultimately flowing into Inner Galway Bay SPA c.21.9km downstream.
Connemara Bog Complex SPA (004181)	Cormorant (*Phalacrocorax carbo*) [A017] Merlin (*Falco columbarius*) [A098] Golden Plover (*Pluvialis apricaria*) [A140] Common Gull (*Larus canus*) [A182]	4.8km	No connectivity via surface water, groundwater or any other pathway.

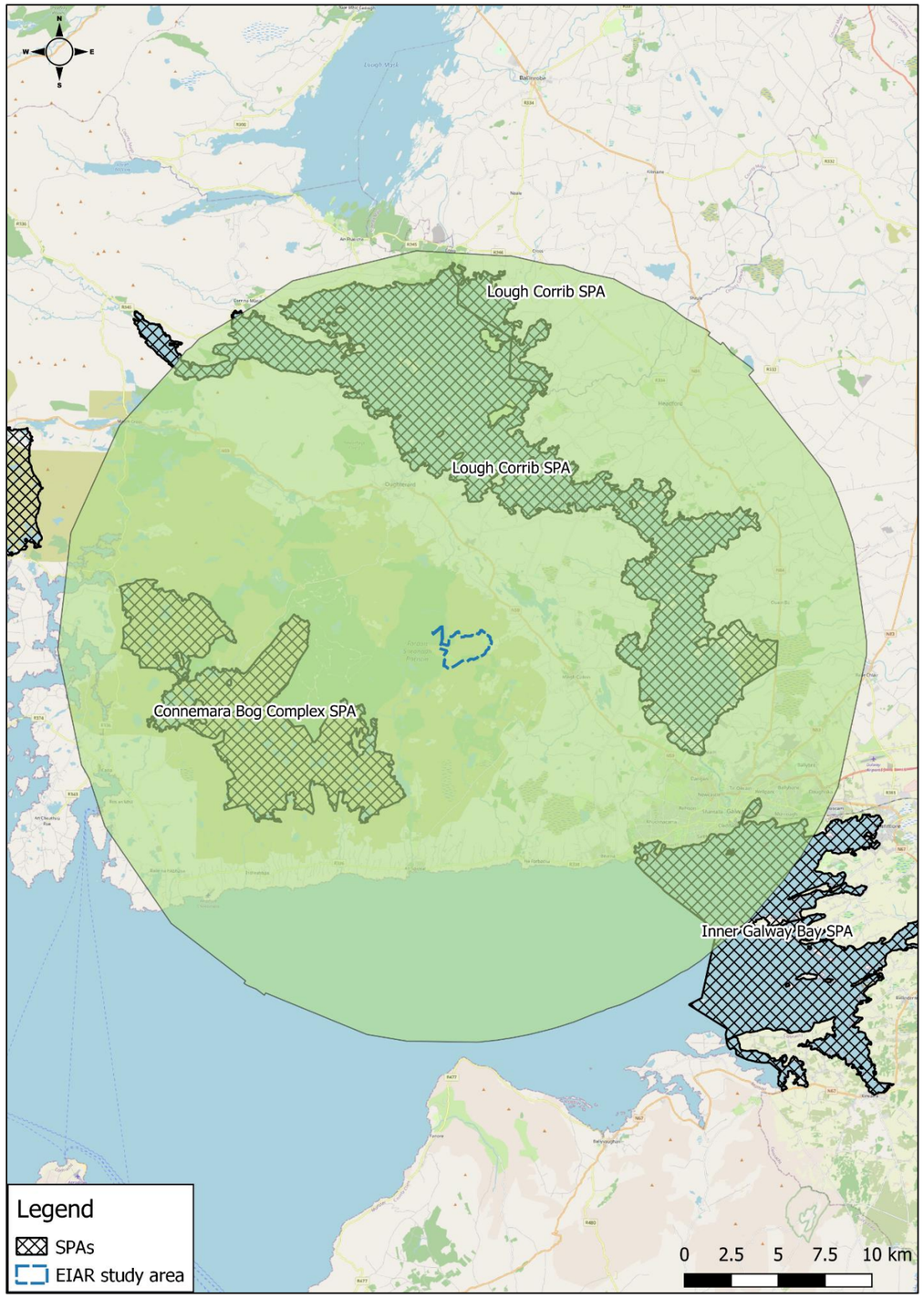

Figure 10.3 SPAs within 20km of the EIAR study area

10.3.2. Important Bird and Biodiversity Areas (IBAs), and Ramsar Sites

The Important Bird and Biodiversity Areas (IBAs) Programme, overseen by Birdlife International, aims to identify, conserve and protect those areas throughout the world considered to be of the greatest significance to bird

populations[6]. The desk-top review concluded that there are three IBA sites within 20 km of the site boundary (see Table 10-7).

The Convention on Wetlands, also known as the Ramsar Convention, is an intergovernmental treaty which aims to conserve and protect wetlands and their resources around the world[7]. It was ratified by Ireland in 1984 and came into force on 15th March 1985. While this convention is not legislation, it is an international treaty. Ireland presently has 45 sites designated as Wetlands of International Importance, with a surface area of 66,994 hectares.

The desk-top review concluded that there two Ramsar sites within 20 km of the site boundary (see Table 10-8).

Table 10-7: IBA Sites within 20km of the Proposed Development

Site Name & Code	Approximate distance from IBA to proposed development site	IBA Trigger Species
Connemara Bogs (southeast), including Roundstone Bog (IE055)	4.5km	The site is important for Golden Plover (Pluvialis apricaria), providing nesting and foraging habitat, and supporting over 21% of the national breeding population. Merlin (Falco columbianus) Red Grouse (Lagopus lagopus)
Lough Corrib (IE056)	6.6km	This is an important site for waterfowl, waders, seabirds and other water birds
Inner Galway Bay (IE057)	13.2km	This is an important site for waterfowl, waders, seabirds and other water birds

Table 10-8: Ramsar sites within 20km of the Proposed Development

Site Name & Code	Approximate distance from Ramsar site to proposed development site	Ramsar Trigger Species
Lough Corrib (846)	6.6km	Common scoter (*Melanitta nigra*) Breeding terns Breeding gulls Breeding waders
Inner Galway Bay (838)	13.2km	Black-throated diver (*Gavia arctica*) Great northern diver (*Gavia immer*) Golden plover (*Pluvialis apricaria*) Sandwich tern (*Thalasseus sandvicensis*) Common tern (*Sterna hirundo*)

10.3.3. BirdWatch Ireland Bird Sensitivity Tool

A Bird Sensitivity Mapping Tool for wind energy development was developed by BirdWatch Ireland and provides a measured spatial indication of where protected birds are likely to be sensitive to wind energy developments. The tool can be accessed via the National Biodiversity Data Centre Website (www.biodiversityireland.ie) and is accompanied by a guidance document (McGuinness et al., 2015). The criteria for estimating a zone of sensitivity (i.e., 'low,' 'medium,' 'high' and 'highest') is based on a review of the behavioural, ecological, and distributional data available for each species.

A review of this mapping tool determined that no bird sensitivity ratings, as above, have been assigned to the area within which the proposed wind farm is encompassed.

10.3.4. IWeBS Sites

I-WeBS (Irish Wetland Bird Survey) is a joint project between BirdWatch Ireland and National Parks and Wildlife (NPWS) in which specific wetland sites are surveyed (BirdWatch Ireland, 2019). In order to count the wetland birds, a 'look-see' method (Bibby et al, 2000) is used in which all birds present within a pre-defined area are counted. The aim of these surveys is to monitor non-breeding birds in Ireland and contribute to population counts.

The information is also important to help assess the quality of these wetland areas (BirdWatch Ireland, 2019). The bird groups to be counted for I-WeBS consist of swans and geese, ducks, divers, waders and gulls. Counts are made once per month from September to March annually (BirdWatch Ireland, 2019).

There are a total of six I-WeBS sites within 20 km of the subject site. See Table 10-9, below.

Table 10-9: IWeBS Sites within 20km of the Proposed Development[8]

I-WeBS Site	Site Code
Lough Poll	0G020
Lough Corrib	0G004
Doolough Headford (Turloughcor)	0G317
Rostaff Lake	0D305

[6] http://www.birdlife.org/worldwide/programmes/important-bird-and-biodiversity-areas-ibas [Accessed: March 2023]
[7] http://www.ramsar.org/ [Accessed: March 2023]
[8] https://bwi.maps.arcgis.com/apps/View/index.html?appid=1043ba01fcb74c78bc75e306eda48d3a [Accessed: March 2023]

Lough Adrehid	0GS28
Lough Aughawoolia	0G040

10.3.5. Bird Atlas Records and Distribution

Bird Atlas 2007-11: The breeding and wintering birds of Britain and Ireland' (Balmer et al., 2013) is the most recent comprehensive work on wintering and breeding birds in Ireland. Previous Bird Atlases have been the primary source of information on the distribution and abundance of British and Irish birds prior to Bird Atlas 2007–11. The three previously published atlases were:

- Sharrock, J.T.R. (1976) The atlas of breeding birds in Britain and Ireland.
- Lack, P.C. (1986) The atlas of wintering birds in Britain and Ireland.
- Gibbons, D.W., Reid, J.B. & Chapman, R.A. (1993) The new atlas of breeding birds in Britain and Ireland: 1988-1991.

The proposed development lies entirely within the hectad (OS 10km grid square) M13. Table 10-10 presents Wintering and Breeding Bird Atlas data (2007 – 2011) of potential target species recorded within this hectad.

Table 10-10: Breeding Bird Atlas Data (M13) with Breeding and Wintering Status[9]

Species Name	Breeding Atlas (07-11)	Wintering Atlas (07-11)	Conservation Status[10]
Barn Owl (*Tyto alba*)	-	Present	RL, IV
Black-headed Gull (*Larus ridibundus*)	-	Present	AL, SCI
Common Gull (*Larus canus*)	Confirmed	Present	AL, SCI
Common Sandpiper (*Actitis hypoleucos*)	Probable	-	AL
Common Snipe (*Gallinago gallinago*)	Probable	-	RL
Cormorant (*Phalacrocorax carbo*)	-	Present	AL, SCI
Curlew (*Numenius arquata*)	Possible	-	RL
Golden Plover (*Pluvialis apricaria*)	-	Present	RL, BD, SCI
Goshawk (*Accipiter gentilis*)	-	Present	AL, IV
Grey Heron (*Ardea cinerea*)	Probable	Present	GL, SCI
Hen Harrier (*Circus cyaneus*)	Possible	Present	AL, IV, SCI, BD
Jack Snipe (*Lymnocryptes minimus*)	-	Present	GL
Kestrel (*Falco tinnunculus*)	Confirmed	Present	RL
Lapwing (*Vanellus vanellus*)	Probable	-	RL, SCI
Long-eared Owl (*Asio otus*)	Probable	-	IV, GL
Mallard (*Anas platyrhynchos*)	-	Present	AL
Merlin (*Falco columbarius*)	-	Present	IV, AL, SCI
Mute Swan (*Cygnus olor*)	Probable	Present	AL
Peregrine Falcon (*Falco peregrinus*)	-	Present	BD, GL, IV
Red Grouse (*Lagopus lagopus*)	Probable	Present	RL
Red-breasted Merganser (*Mergus serrator*)	Probable	-	AL, SCI

[9] Breeding status: Seen = recorded; Possible = possible breeding; Probable = probable breeding; Confirmed = confirmed breeding; - = not recorded; Non-B = non-breeding; Breed = breeding

[10] Conservation Status: BD = Annex I of the Birds Directive; RL = BoCCI Red-listed; AL = BoCCI Amber-listed; GL= BoCCI Green-listed; SCI = Species Conservation Interest of nearby SPA; Schedule IV = protected under Schedule IV of the Wildlife Act

Redshank (*Tringa totanus*)	Probable	-	RL, SCI
Ringed Plover (*Charadrius hiaticula*)	Probable	-	AL, SCI
Sparrowhawk (*Accipiter nisus*)	Confirmed	Present	GL, IV
Teal (*Anas crecca*)	Confirmed	-	AL, SCI
Tufted Duck (*Aythya fuligula*)	-	Present	AL, SCI
Whooper Swan (*Cygnus cygnus*)	-	Present	AL, BD
Woodcock (*Scolopax rusticola*)	-	Present	RL

10.3.6. NPWS Rare and Protected Species Dataset

An information request was sent to the NPWS requesting records from the Rare and Protected Species Database for the hectad M13 encompassing the proposed wind farm site. No relevant records regarding protected bird species was provided by the NPWS (13th April 2023) for the hectad M13. However, it was noted that "the absence of information in the NPWS dataset for an area, does not necessarily imply a low biodiversity value for that area," and that "the NPWS species dataset is incomplete, particularly for birds." The NPWS dataset hold additional bird data for the hectads overlapping a 5km buffer of the EIAR study area: one occupied nest site for Peregrine Falcon was recorded during the 2017 National Peregrine Survey within Hectad M13 and Hectad M23.

10.3.7. Ornithological Survey Results for the Permitted Development

A total of 26 species were recorded during the breeding season. Of these species, 2 were Red listed on the BoCCI (Golden Plover and Red Grouse) and 4 were Amber listed (Skylark, Swallow, Wheatear and Kestrel). The most common breeding species within the study area were Skylark and Meadow Pipit, which reflects the extent of wet heath and blanket bog habitat within the study area.

The only species of note observed during the upland bird survey was Red Grouse, which was flushed from wet heath/blanket bog habitat and at the edge of cutover bog at the centre and the extreme north-west of the study area on two occasions.

The only raptor observed during the summer VP survey was Kestrel, which was observed on two occasions to the south and west of VP2. A flock of Golden Plover was observed flying in a northerly direction from VP1 and a single bird was also heard within the study area.

During the targeted Red Grouse survey, a single individual was flushed out in the mid-west of the study area. Evidence of this species in the form of droppings, feather and caecal droppings were also recorded in the south-west, middle, mid-west and north-west; feathers were also recorded outside the study area to the south in blanket bog habitat. It was considered likely that the study area supports a breeding pair territory or that the study area is part of a territory of a breeding pair.

No evidence of breeding Merlin during the breeding Merlin survey or any other survey undertaken to inform the EIS.

A total of 29 species were recorded within the site and a 2km radius of the site during the course of winter bird surveys. Of these species, one was Red listed on the BoCCI: Red Grouse; and 10 were Amber listed: Skylark, Snipe, Golden Plover, Kestrel, Whooper Swan, Little Grebe, Cormorant, Teal, Kestrel and Golden Plover.

One of the objectives of the winter VP surveys was to estimate the degree of usage of the site for wintering wildfowl. As noted in the EIS, small numbers of Greenland White-fronted Geese (*Answer albifrons flairostris*) are known to frequent an area between Tullynaheoy Lake and Boliska Oughter, located c.8km south-west of the study area. Small numbers of Whooper Swan (*Cygnus cygnus*) are known to occupy Seecon Lough, c.6km north-west of the site, Lough Bealanambrack c.6km south-west and Seecon Lough. During the course of the surveys completed to inform the EIS, 3 Whooper Swans were recorded at Seecon Lough. Greenland White-fronted Goose was not recorded from any VP. Golden Plover was recorded over wet heath/blanket bog at the west of the site and a flock of c.300 birds was recorded flying in a westerly direction at the west of the site.

10.4. Identification of Target Species

The following table (Table 10-11) outlines those species for which past records exist and which meet one or more of the target species selection criteria as outlined in Section10.2.4. Subject site sensitive species meeting the selection criteria that were not identified as having previously occurred within the relevant hectad during the desk study search for previous species records, such as buzzard, were also included as target species on a precautionary basis. The conservation status/level of protection afforded to each species is also included.

As outlined previously, and as set out in SNH (2017), target species typically comprise those species which are afforded a higher level of legislative protection and should be restricted to those likely to be affected by subject sites. Therefore, only red-listed species have been included as target species, unless the species meets one of the other target species selection criteria as outlined previously, e.g. Annex I. However, to ensure other species which may potentially be sensitive to subject sites were not missed during surveys, all other species were included as secondary species.

Table 10-11: Target Species for the Proposed Development

Target Species	Conservation Status	Typical Habitat[11]
Arctic Tern (*Sterna paradisaea*)	Annex I EU Birds Directive/BoCCI Amber listed/ Wildlife Acts	**Breeding** Mainly a coastal breeding bird, but in Ireland the species also breeds inland on freshwater lakes such as Lough Corrib (Co. Galway). **Wintering** Does not winter in Ireland. Considered to have the longest migration of all birds, utilizing the summer of both hemispheres.
Barn Owl (*Tyto alba*)	BoCCI Red-listed/ IV Schedule Wildlife Act	**Breeding** Breeds in ruined buildings, such as castles and to a lesser extent in outbuildings (barns/sheds). Will use special nest boxes. Breeding success heavily dependent on the availability of suitable prey. **Wintering** Largely resident, though young birds will wander in search of new territories.
Buzzard (*Buteo buteo*)	BoCCI Green-listed/ IV schedule Wildlife Act	**Breeding** Widespread breeding species. Nests in trees and sometimes on cliffs, usually with access to open land including farmland, moorland and wetland. **Wintering** Largely resident.
Common scoter (*Melanitta nigra*)	BoCCI Red-listed/Wildlife Acts	**Breeding** They nest on islands with dense covering of scrub and tree cover. The breeding population has declined since due to the increase in mink (Mustela vison), which predate the nests and young. **Wintering** Common Scoter are almost entirely marine during the winter and tend to congregate in large flocks on shallow seas with sandy bottoms supporting their preferred prey.
Common Tern (*Sterna hirundo*)	Annex I EU Birds Directive/BoCCI Amber listed/ Wildlife Acts	**Breeding** Nest colonially on the ground from April to October. Breeds on the coast, with larger colonies in Co. Dublin, Co. Wexford and Co. Galway. Also breeds inland on islets in freshwater lakes, notably in Co. Galway and in Co. Mayo. **Wintering** Does not winter in Ireland.
Curlew (*Numenius arquata*)	BoCCI Red-listed/Wildlife Acts	**Breeding** Nests on the ground in rough pastures, meadows and heather. Not a common breeder but found in most parts of the country. **Wintering** Winters in a wide range of wetland habitats (coastal and inland) and other good feeding areas including damp fields.
Golden Plover (*Pluvialis apricaria*)	Annex I EU Birds Directive/BoCCI Red listed/ Wildlife Acts	**Breeding** Breeds in heather moors, blanket bogs & acidic grasslands. Distribution limited to the uplands of north-western counties in Ireland. **Wintering** Throughout the winter, Golden Plovers are regularly found in large, densely packed flocks, and in a variety of habitats, both coastal and inland. Their distribution is widespread in Ireland.
Hen Harrier (*Circus cyaneus*)	Annex I EU Birds Directive/BoCCI Amber listed/ IV Schedule Wildlife Acts	**Breeding** Breeding birds are confined largely to heather moorland and young forestry plantations, where they nest on the ground. **Wintering** Spends winter in more coastal and lowland areas throughout Ireland hence most easily seen on the coast in the winter months.
Kestrel (*Falco tinnunculus*)	BoCCI Red-listed/ IV Schedule Wildlife Act	**Breeding** A widespread breeder throughout the country. Nests in trees, buildings or in cracks in cliffs. Will use old crows' nests. Found in wide variety of open habitats including coasts, moorland, farmland, wetlands, roadside verges and town parks. **Wintering** Largely resident within breeding territory. Some birds move within the country, especially down from the uplands.
Lapwing (*Vanellus*	BoCCI Red-listed/ Wildlife Acts	**Breeding**

[11] birdwatchireland.ie

vanellus)		They breed on open farmland and appear to prefer nesting in fields that are relatively bare (particularly when cultivated in the spring) and adjacent to grass. **Wintering** Wintering distribution in Ireland is widespread. Large flocks regularly recorded in a variety of habitats, including most of the major wetlands, pasture and rough land adjacent to bogs.
Long-eared Owl (*Asio otus*)	IV Schedule Wildlife Act/ BoCCI Green-listed	**Breeding** Breeds in lowlands throughout Ireland, usually in a stand of conifers. **Wintering** Largely resident, though young birds will wander in search of new territories. During winter, may occasionally gather in communal roosts of between 5 and 30 birds.
Merlin (*Falco columbarius*)	Annex I EU Birds Directive/ BoCCI Amber listed/ IV Schedule Wildlife Act	**Breeding** A rare breeding bird in Ireland. Nests on the ground on moorland, mountain and blanket bog. Also nests in woodland and has taken to nesting in forestry plantations adjacent to moorland. **Wintering** Much more widely distributed in the winter, than in the breeding season. Merlin move away from high ground at this time of the year and can often be seen at the coast where concentrations of other birds are attractive as prey species
Peregrine Falcon (*Falco peregrinus*)	Annex I EU Birds Directive / BoCCI Green listed/ IV Schedule Wildlife Act	**Breeding** Breeds on coastal and inland cliffs. Most birds on the coast breed on the south, west and north coasts, coastal breeding on the east coast is limited by the availability of suitable nesting cliffs. Most inland birds breed on mountain cliffs but will also breed at lower levels. **Wintering** Resident in Ireland but shows some movement away from its breeding areas in the winter. Can be found on the coast, especially on estuaries where they hunt water birds. Some birds move into cities. Wintering birds may also comprise individuals which have arrived from Britain or even further afield.
Pochard (*Aythya farina*)	BoCCI Red-listed/ Wildlife Acts	**Breeding** Scarce summer visitor. Nests on the ground among waterside vegetation. **Wintering**
		Widespread winter migrant. Shows a preference for large shallow eutrophic waters, particularly those with well vegetated marshes and swamps and slow-flowing rivers.
Red Grouse (*Lagopus lagopus hibernicus*)	BoCCI Red-listed/ Wildlife Acts	**Breeding** Nest on the ground. Found on mountains, moorland and lowland blanket bogs and raised bogs, where it is associated with heather which it requires for food, shelter and nesting. As a 'game' species it had benefited from past management of heather moorland. **Wintering** Resident and sedentary (non-migratory). Will move in the winter to wind swept ridges and lower ground, if snow is on the ground.
Redshank (*Tringa totanus*)	BoCCI Red-listed/ Wildlife Acts	**Breeding** Nests on the ground in grassy tussocks, in wet, marshy areas and occasionally heather. Breeds mainly in midlands (especially Shannon Callows) and northern half of the country. **Wintering** Winters all around the coasts of Ireland, Britain and many European countries. Favours mudflats, large estuaries and inlets. Smaller numbers at inland lakes and large rivers.
Sandwich Tern (*Sterna sandvicensis*)	Annex I EU Birds Directive/BoCCI Amber listed/ Wildlife Acts	**Breeding** Nest colonially on the ground, mainly on the coast but with some colonies inland. Nests on islands, shingle spits and sand dunes. Populations of colonies fluctuate dramatically between years. Present in Ireland from March to September, with occasional winter records. **Wintering** Winters in southern Europe and Africa. Irish breeders have been recorded as far away as the Indian Ocean. About 10 to 15 birds winter in Galway Bay and Strangford Lough.
Shoveler (*Anas clypeata*)	BoCCI Red-listed/ Wildlife Acts	**Breeding** Nests on the ground among waterside vegetation, often many nests in close proximity. Breeding in Ireland is centred around Lough Neagh and the mid- Shannon Basin. **Wintering** Shoveler prefer shallow, eutrophic waters rich in plankton, and occur on a variety of habitats while wintering in Ireland, including coastal estuaries, lagoons and inland lakes and callows.
Snipe	BoCCI Red-listed/	**Breeding**

(*Gallinago gallinago*)	Wildlife Acts	Nests on the ground, usually concealed in a grassy tussock, in or near wet or boggy terrain. **Wintering** Highly dispersed distribution in winter. They forage across a variety of wetland and damp habitats. Particularly high concentrations are found on the fringes of lowland lakes.
Sparrowhawk (Accipiter nisus)	BoCCI Green-listed/ IV Schedule Wildlife Act	**Breeding** Probably the most common bird of prey in Ireland. Widespread in woodland, farmland with woods, larger parks and gardens. **Wintering** Resident in Ireland. Can be seen throughout the country.
White-tailed Eagle (*Haliaeetus albicilla*)	Annex I EU Birds Directive/BoCCI Red listed/ IV Schedule Wildlife Act	**Breeding** Mixed success in terms of breeding in Ireland since the recent reintroduction at Mountshannon and Portumna. Historically a widespread breeding species, and formerly the last wild pair bred in County Mayo in 1912. This is reflected in the prevalence of place names in western Ireland referencing "eagles". **Wintering** Resident. Young birds move to new territories after fledging.
Whooper Swan (*Cygnus cygnus*)	Annex I EU Birds Directive/BoCCI Amber listed/ Wildlife Acts	**Breeding** The Whooper Swans that are present in Ireland each winter nest in Iceland during the summer. Each year a small number of Whoopers stay in Ireland for the summer and there have been occasional breeding records on lakes in the midlands and northwest. **Wintering** Most on lowland open farmland around inland wetlands, regularly seen while feeding on grasslands and stubble.
Woodcock (Scolopax rusticola)	BoCCI Red-listed/ Wildlife Acts	**Breeding** Nests on the ground in forests and woodland, usually well camouflaged amongst dead leaves and low vegetation. **Wintering** Wider distribution in winter, occurring in woodland, also scrub and some open areas (bracken and heather-covered hills).

10.5. Field Survey

10.5.1. Target Species Observations

A total of nine target species and seven species of secondary interest were recorded during the field surveys undertaken between February 2022 and March 2023. The following sections describe the observations of each target species.

Survey data for each survey type are summarised in Section 10.5.2 to Section 10.5.7. Maps of target species observations are enclosed in Appendix 10.2.

10.5.1.1. White-tailed Eagle

White-tailed Eagle were recorded on three occasions during VP surveys undertaken in February 2022 during surveys at VP1 and VP3. A single bird was recorded on two occasions flying within Potential Collision Height (PCH[12]) and a single bird was recorded perching within bog habitat on one occasion.

No additional records of this species were recorded during surveys.

10.5.1.2. Kestrel

During the 2022/2023 VP surveys, kestrel was recorded on one hundred and twenty-nine occasions, with eight records of perching birds (not in flight). One-hundred and twenty of the flights recorded within the turbine buffer were recorded flying within the potential collision risk height. Kestrel was recorded on fifty observations in June and July 2022; the majority of the kestrel hunting activity observed during these months was in the area to the south of VP1 within the 500m site buffer, with occasional activity within the site boundary.

Kestrel was observed on three occasions during winter walkovers in March 2022. All observations were of individual birds flying below the potential collision risk height.

10.5.1.3. Sparrowhawk

During the VP surveys, sparrowhawk was observed on eight occasions, all of which were records of flights within the potential collision risk height. Seven observations were of individual birds and one observation was of two birds (sex unknown) flying and hunting within forestry.

10.5.1.4. Hen Harrier

During the VP surveys, hen harrier was observed on three occasions, all of which were records of flights within the potential collision risk height. All three observations were of individual birds flying and hunting within forestry and bog habitats. No evidence of roosting was recorded.

[12] PCH= 12-150m, see Table 10-5

10.5.1.5. Peregrine Falcon

During the VP surveys, peregrine falcon was observed on two occasions, both of which were records of flights within the potential collision risk height. Both observations were of individual birds flying over bog habitats.

10.5.1.6. Snipe

During the VP surveys, snipe was observed on fifteen occasions, predominantly perching or flying low over bog, grassland and moorland habitats. Snipe were also heard drumming (displaying) from VP1 indicating a breeding pair close by. The most suitable breeding habitat is south of VP1 closer to the site boundary.

Snipe were also recorded on nine occasions as they were flushed out during the winter walkover surveys undertaken in 2022 and 2023 and on two occasions during the hinterland survey undertaken in 2022.

10.5.1.7. Red Grouse

During the VP surveys, red grouse was observed on four occasions, none of which were within the potential collision risk height (PCH).

Red grouse were flushed out during the winter walkover surveys undertaken on 10th February 2022 and 16th March 2022 and fresh pellets were recorded on 28th February 2022, likely from a recent roost.

10.5.1.8. Golden Plover

During the VP surveys, golden plover was recorded on five occasions. One of the observations of Golden Plover was not within the viewshed. All of the observations occurred during winter months with four occurring during October 2022 and one in December 2022. The largest observed flock contained one hundred and eight birds, which were recorded flying and circling at a height of between 2 and 200m. Four of the observed flights occurred within the potential collision risk zone.

An incidental recording was also made of golden plover in January 2023, where this species was heard but not seen to the north-east during the survey from VP4.

10.5.1.9. Whooper Swan

During the VP surveys, whooper swan was recorded on one occasion. Five birds were recorded at VP 2 flying and calling at a height of between 50 and 180m (i.e., within the potential collision risk zone).

Four observations of whooper swan were also made during the waterbird counts undertaken in March 2022.

10.5.1.10. Cormorant

During the 2022/2023 surveys, cormorant was recorded on three occasions during the VP watches. All three of the observations were of single birds flying within the potential collision risk height.

There were two observations of cormorant during the waterbird counts undertaken in March 2022, one observation during the winter walkover survey undertaken in March 2023 and three observations during the hinterland surveys undertaken in 2022 and 2023.

10.5.1.11. Mallard

During the 2022/2023 surveys, mallard was recorded on twelve occasions during the VP watches. All twelve of the observations were of birds flying under the potential collision risk height.

There were eight observations of mallard during the waterbird counts undertaken in March 2022, two observations of loafing Mallard during the winter walkover survey undertaken in March 2023 and nine observations of flying Mallard during the hinterland surveys undertaken in May 2022.

10.5.1.12. Common Gull

During the VP surveys, common gull was recorded on two occasions. Both of the observations were of single birds, one of which was flying within the potential collision risk zone and one was flying below the potential collision risk zone.

Twenty common gull were recorded during the waterbird counts undertaken in March 2022 and fifteen were recorded during the hinterland surveys undertaken in February 2022 and March 2023.

10.5.1.13. Common Sandpiper

A single common sandpiper was recorded feeding during the hinterland survey undertaken on 10th May 2022.

10.5.1.14. Grey Heron

During the VP surveys, grey heron was recorded on two occasions. Both of the observations were of single birds, flying within the potential collision risk zone.

One grey heron was recorded during the waterbird count undertaken in March 2022 and one grey heron was recorded standing in water during the hinterland surveys undertaken in May 2022.

10.5.1.15. Teal

During the 2022/2023 surveys, teal was recorded on four occasions during the VP watches. Three of the observations were of birds flying under the potential collision risk height and one was an auditory record.

There were six observations of teal during the waterbird counts undertaken in March 2022 and eleven observations of Teal during the hinterland surveys undertaken in May 2022.

10.5.1.16. Mute Swan

No mute swan were recorded during the VP surveys undertaken in 2022 and 2023. Two mute swan were recorded during the waterbird survey undertaken in March 2022 and two mute swan were recorded during the hinterland survey undertaken in March 2023.

10.5.2. Vantage Point Survey Results

Fifteen species of interest, including nine target species and six species of secondary interest (i.e. species of gull, wader, duck, diver, goose, swan, cormorant, and heron see Section 10.2.4) were recorded during the Vantage Point surveys undertaken between February 2022 and March 2023 at Cnoc Raithní, as outlined below (Annex I

species are in bold). Survey results are separated into raptors (Section 10.5.2.1 and Table 10-12) and non-raptors (Section 10.5.2.2 and Table 10-13).

10.5.2.1. Raptors

- Hen Harrier (*C. cyaneus*)
- Kestrel (*F. tinnunculus*)
- Sparrowhawk (*A. nisus*)
- White-tailed Eagle (*H. albicilla*)
- Peregrine (*F. peregrinus*)

Table 10-12: Summary of VP results February 2022- March 2023 (raptors)

Month	Species Observed	Activity	No. of Times Observed
February 2022	White-tailed Eagle	Flying	3
March 2022	Kestrel	Perching, flying & hunting	2
March 2022	Sparrowhawk	Flying	1
April 2022	Kestrel	Flying &hunting	2
May 2022	Hen Harrier	Flying	1
May 2022	Sparrowhawk	Perching & hunting	1
May 2022	Kestrel	Hunting	2
June 2022	Kestrel (pair)	Flying & hunting	13
July 2022	Kestrel (pair)	Flying & hunting	37
August 2022	Sparrowhawk (pair)	Flying & hunting	3
August 2022	Kestrel	Flying	15
August 2022	Peregrine	Flying	1
September 2022	Kestrel	Flying	4
October 2022	Kestrel	Flying, hunting & perched	4
October 2022	Sparrowhawk	Flying	1
November 2022	Hen Harrier	Flying	1
December 2022	Kestrel	Flying, hunting & perched	1
January 2023	Peregrine Falcon	Flying	1
February 2023	Kestrel	Flying, hunting & hovering	3
February 2023	Sparrowhawk	Flying & hunting	1
February 2023	Hen Harrier	Flying & hunting	1
March 2023	Kestrel	Flying, hunting, circling, soaring, riding thermal, on ground	10
March 2023	Sparrowhawk	Circling & soaring	1

10.5.2.2. Non-raptors

- Golden Plover (*Pluvialis apricaria*)
- Grey Heron (*A. cinerea*)
- Mallard (*A. platyrhynchos*)
- Lesser Black-backed Gull (*Larus fuscus*)
- Common Gull (*Larus canus*)
- Cormorant (*Phalacrocorax carbo*)
- Red Grouse (*Lagopus lagopus hibernicus*)
- Snipe (*G. gallinago*)
- Teal (*A. creca*)
- Whooper Swan (Cygnus cygnus)

Table 10-13: Summary of VP results February 2022- March 2023 (on-raptors)

Month	Species Observed	Activity	No. of Times Observed
February 2022	Common Gull	Flying	1
February 2022	Cormorant	Flying	1
March 2022	Mallard	Flying	3

March 2022	Snipe	Flying	2
March 2022	Teal	Flying	2
April 2022	Snipe	Perching & Flying	3
April 2022	Common Gull	Flying	1
April 2022	Mallard	Flying	2
April 2022	Teal	Flying	2
April 2022	Red Grouse	Flying	1
May 2022	Snipe	Flying	3
May 2022	Mallard	Flying	3
May 2022	Grey Heron	Flying	1
May 2022	Red Grouse	Flying	1
June 2022	Lesser Black-backed Gull	Flying	1
July 2022	Red Grouse	Calling	1
July 2022	Grey Heron	Flying	1
July 2022	Lesser Black-backed Gull	Flying	1
July 2022	Snipe	Feeding & Displaying	3
August 2022	Red Grouse	Calling	1
October 2022	Golden Plover	Flying, circling	4
October 2022	Snipe	Flying	1
November 2022	Nil sightings		
December 2022	Golden Plover	Flying	1
December 2022	Red Grouse	Flying	1
January 2023	Cormorant	Flying	1
January 2023	Snipe	Flushed, flying	1
February 2023	Cormorant	Flying	1
February 2023	Mallard	Flying	3
February 2023	Snipe	Flying, calling	2
March 2023	Mallard	Flying	1
March 2023	Whooper Swan	Flying, calling	1

10.5.3. Waterbird Count Survey

Seven species of secondary interest and one target species were recorded during the waterbird survey at Cnoc Raithní in March 2022. See Table 10-14 for results (Annex I species are in bold).

Table 10-14: Summary of results- waterbirds

Date	Species Observed	Number Observed
1st March 2022	Common Gull	20
	Coot	1
	Cormorant	2
	Grey Heron	1
	Mallard	8
	Mute Swan	2
	Teal	6
	Whooper Swan	4

10.5.4. Hen Harrier Roost Survey

There were nil sightings of Hen Harrier during the Hen Harrier roost watches undertaken in February 2022, March 2022, April 2022 and January 2023.

10.5.5. Winter Walkover Survey Results

Two species of secondary interest and three target species were recorded during the winter walkover surveys undertaken in February 2022, March 2022, February 2022 and March 2023 at Cnoc Raithní. See Table 10-15 below, for results.

Table 10-15: Summary of results- winter walkover

Date	Species Observed	Activity	Number of Observations
10th February 2022	Snipe	Flushed	1
28th February 2022	Red Grouse Snipe	Fresh pellets from recent roost Flushed	1 2
7th March 2022	No target species observed Meadow Pipit Skylark	 Flying Singing/territorial display	 3 1
16th March 2022	Red Grouse Kestrel	Flushed Droppings and feathers Flying	1 2 3
7th February 2023	Snipe	Flushed	3
25th March 2023	Cormorant Mallard Snipe	Flying Loafing Flushed	1 2 3
	Grey Heron Mallard Teal	Roosting Flying Breeding/Male displaying	1 9 11
7th March 2023	Common Gull Cormorant Mute Swan		4 3 2

10.5.6. Hinterland Survey Results

Seven species of secondary interest and two target species were recorded during the hinterland survey undertaken in May 2022, September 2022 and March 2023 at Cnoc Raithní. See Table 10-16 below, for results.

Table 10-16: Summary of results- hinterland surveys

Date	Species Observed	Activity	Number of Observations
10th February 2022	Snipe	Flushed	2
28th February 2022	Red Grouse Common Gull Common Gull	Fresh pellets from recent roost Breeding/incubation Flight	1 8 3
10th May 2022	Common Sandpiper	Feeding	1

10.5.7. Incidental Sightings

The following is a list of incidental sightings that occurred outside the designated survey periods:

- Two snipe were flushed on the way to VP2 during the February vantage point survey.
- Red Grouse heard calling during the April Hen Harrier roost survey.
- Red Grouse sighted during the April vantage point survey.

The following is a list of incidental sightings that occurred outside the designated survey periods:

- At 10:45 Golden Plover was heard but not seen during the VP4 October survey.
- At 07:49 Red Grouse was heard calling to the north-west during the December VP3 survey.
- At 08:00 Red Grouse was heard calling to the south-east during the January VP4 survey.
- At 08:39 Golden plover was heard but not seen to the north-east during the January VP4 survey.

10.5.8. Evaluation

Table 10-17 summarises the ecological evaluation of target species and species of secondary interest. A determination of receptor evaluation of birds within the likely zone of influence is provided in Table 10-17 following criteria described in Section 10.2.6. Estimates of National population sizes were obtained from the NPWS Article 12 Reporting (2008- 2012) (available at Factsheet (europa.eu)) which details the status and trends of Irelands Bird species. The bird sensitivity within the study area is also provided in Table 10-17, following criteria developed by Percival (2003) as presented in Table 10-2 (Section 10.2.6).

Table 10-17: Avifauna Key Receptor Evaluation and Selection Criteria

Species	NRA Evaluation and Rationale	Key Receptor (Yes/No)	Receptor Evaluation for Impact Assessment (Sensitivity)
Common Gull	The estimated national population of wintering common gull in Ireland is 1,948[13]. 1% of the ROI National wintering population of common gull is 194. As per NRA 2009, a regularly occurring population of 194 common gull is required for classification as Internationally Important. The maximum number of birds recorded from the winter season was twenty during a waterbird count in March 2022. This maximum number of twenty birds recorded represents a population of no greater than Local Importance (higher value).	Yes	Very High (Amber listed, SCI species)
Common Sandpiper	The species is Amber listed in Ireland. Common Sandpiper has a breeding population of 1,848 in Ireland. A single Common Sandpiper was recorded on one occasion during a hinterland survey. The resident population was assigned Local Importance (Lower Value).	No	Low Amber listed
Cormorant	The estimated national wintering population of Cormorant in Ireland is 7,967. 1% of the ROI National wintering population of Cormorant is 80. As per NRA 2009, a regularly occurring population of 80 Cormorant is required for classification as Internationally Important. Observations were mainly of single birds. The maximum count of birds was three during a hinterland survey undertaken in March 2023. This maximum number represents a population of no greater than Local Importance (higher value).	Yes	Very High (Amber listed, SCI species)
Golden Plover	The estimated national wintering population of Golden Plover in Ireland is 99,870. 1% of the ROI National wintering population of Golden Plover is 999. As per NRA 2009, a regularly occurring population of 999 Golden Plover is required for classification as Internationally Important. The maximum number of birds recorded from the winter season was a flock of one hundred and eight birds during a VP survey on the 26th October 2022. This maximum number does not correspond with the classification criteria for National or International Importance (Lewis et al, 2019). This maximum number of one hundred and eight birds recorded represents a population of no greater than Local Importance (higher value).	Yes	Very High (SCI species, Annex I EU Birds Directive/BoCCI Red listed/ Wildlife Acts)
Grey Heron	The species is Green listed in Ireland. Grey Heron has a breeding population of 3,087 in Ireland. The resident population was assigned Local Importance (Higher Value).	Yes	Very High (SCI species)
Hen Harrier	As per the NPWS Article 12 Reporting, the estimated national wintering population of Hen Harrier in Ireland is 269-349. 1% of the ROI National wintering population is 2-3 birds. As per NRA 2009, a regularly occurring population of 2-3 Hen Harrier is required for classification as Internationally Important. Single hen harriers were recorded on three occasions during the site surveys. No evidence of roosting was recorded. Hen harrier is an Annex I species. Taking a precautionary approach, it is considered that birds recorded during surveys at the site are associated with a population of National Importance.	Yes	Very High (SCI species, Annex I EU Birds Directive/BoCCI Amber listed/ IV Schedule Wildlife Acts)
Kestrel	Kestrel is not listed on Annex I of the Birds Directive. Kestrel have a breeding population of 12,100-12,220 in Ireland. The species is Red listed in Ireland (BoCCI). Kestrel was recorded on a total of one hundred and twenty-nine occasions during the VP surveys, with most observations of single birds. The population recorded across the seasons was assigned Local Importance (Higher Value).	Yes	High (BoCCI Red-listed/ IV Schedule Wildlife Act)

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

Mallard	The species is Amber listed in Ireland. Mallard has a breeding population of 15,400 in Ireland. The resident population was assigned Local Importance (Higher Value).	Yes	Very High (Amber listed, SCI species)
Mute Swan	The species is Amber listed in Ireland. Mute swan has a breeding population of 3,560 in Ireland. The resident population was assigned Local Importance (Higher Value).	Yes	Low (Amber listed)
Peregrine Falcon	As per the NPWS Article 12 Reporting, the estimated national breeding population of peregrine falcon in Ireland is 515. 1% of the ROI National breeding population is 5 birds. As per NRA 2009, a regularly occurring population of 5 peregrine falcon is required for classification as Internationally Important. During the VP surveys, peregrine falcon was observed on two occasions, both observations were of individual birds flying over bog habitats. Peregrine falcon is an Annex I species. Taking a precautionary approach, it is considered that birds recorded during surveys at the site are associated with a population of National Importance.	Yes	Very High (Annex I EU Birds Directive / BoCCI Green listed/ IV Schedule Wildlife Act)
Red Grouse	The species is Red listed in Ireland. Red Grouse has a breeding population of 1708-2116 in Ireland. The resident population was assigned Local Importance (Higher Value).	Yes	High (BoCCI Red-listed/ Wildlife Acts)
Snipe	The species is Amber listed in Ireland. Snipe has a breeding population of 4,275 in Ireland. The resident population was assigned Local Importance (Higher Value).	Yes	High (BoCCI Red-listed/ Wildlife Acts)
Sparrowhawk	Sparrowhawk is not listed on Annex I of the Birds Directive. The species is Green listed in Ireland. The population recorded across the seasons was assigned Local Importance (Higher Value).	Yes	Low (IV Schedule Wildlife Act)
Teal	The species is Amber listed in Ireland. Teal has a breeding population of 29,050 in Ireland. The resident population was assigned Local Importance (Higher Value).	Yes	Very High (Amber listed, SCI species)
White-tailed Eagle	This species has been recently reintroduced to Ireland. In 2016 and 2017, ten pairs held territories in Ireland[14]. As a receptor, White Tailed Eagle has been assigned International Importance.	Yes	High (ecologically sensitive, Annex I EU Birds Directive/BoCCI Red listed/ IV Schedule Wildlife Act)
Whooper Swam	As per the latest NPWS Article 12 reporting document the estimated national wintering population of Whooper Swan in Ireland is 10,520. As per the latest I-WeBS figures, 1% of the National population of Whooper Swans is 105. Therefore, as per NRA 2009, a regularly occurring population of 105 Whooper Swans is required for classification as Internationally Important. According to the Swan Census 2020 (Burke *et. al*., 2022), the county population of Whooper Swan in 2020 was 1,485 individuals within 38 flocks. Based on the above, a population of 14/15 Whooper Swan constitutes a population of County Importance in Galway. The maximum number of swans recorded flying over the site was five birds. The recorded evidence does not suggest that the Proposed Development is located on an important migratory route for the species. The maximum number recorded during the waterbird surveys from the surrounding area was four birds. The study area is not considered to be of County, National or International importance for Whooper Swan (Lewis et al, 2019). This maximum number of five birds recorded represents a population of no greater than Local Importance (higher value).	Yes	Medium (Annex I EU Birds Directive/BoCCI Amber listed/ Wildlife Acts)

10.6. Likely Significant Impacts

The construction phase impacts of the Permitted Development on avifauna were assessed in the EIS submitted with that planning application. As detailed in Chapter 2 of this EIAR, the Proposed Development seeks to amend the Permitted Development.

[14] Irish Raptor Study Group Annual Review 2018

The EIS for the Permitted Development fully assessed the likely significant effects of the 11 no. turbine layout and proposed mitigation measures to avoid or reduce these effects. The findings of the assessment and proposed mitigation measures for the Permitted Development will not be altered as a result of the Proposed Development.

Of relevance to the Biodiversity Chapter, and as the baseline against which the Proposed Development is assessed, the following statements from An Bord Pleanala Reference 07.243094 are noted:

> *"The Board was satisfied that it could be concluded beyond reasonable scientific doubt that the proposed development including grid connection, either individually or in combination with other plans and projects, would not adversely affect the integrity of the European sites Connemara Bog Complex Special Area of Conservation (site code number 002034); Ross Lake and Woods Special Area of Conservation (site code number 001312)" [P. 14]*

> *"The Board completed an Environmental Impact Assessment and concluded that the proposed development, subject to compliance with the mitigation measures proposed, and subject to compliance with the conditions set out below, would not have unacceptable impacts on the environment." [P.17]*

All elements of the Proposed Development have been considered in assessing effects on avifaunal receptors, including:

- Alterations to the turbine dimensions;
- Associated increase in turbine foundations;
- The omission of the previously approved on-site 110kV substation and underground cabling;
- Provision of underground electrical (33kV) and communications cabling connecting the 11 no. wind turbines to the Ardderroo wind farm substation;
- Associated road widening and new cable service track and watercourse/culvert crossings;
- Extension of the Ardderroo substation within the existing substation compound, including IPP control building extension (c.75 m2), new 110kV transformer and electrical plant and apparatus;
- Provision of site drainage works in support of the Proposed Development;

Tree felling in support of the Proposed Development. As detailed in Chapter 9: Biodiversity, the Proposed Development will require the removal of c.2.45ha conifer plantation to accommodate an increased felling buffer grid connection and the removal of c.0.72ha scrub to accommodate the grid connection.

10.6.1. Do Nothing Scenario

If the Proposed Development were not to proceed the already permitted 11-turbine layout would proceed under the terms of the Galway County Council Planning Ref. No. 13/829 and An Bord Pleanála Ref: 07.243094 planning permission.

10.6.2. Assessment of Effects During Construction

10.6.2.1. Effects on Designated Sites

The Proposed Development is not located within lands designated for nature conservation (see Figure 10-4). Further, there are no resource requirements (e.g. excavation or abstraction) from European sites for the Proposed Development. Consequently, none of the lands designated as part of European sites will be directly impacted or removed as a result of the Proposed Development. Therefore, there will be no direct impacts to European sites in this regard.

This section provides a summary of the key assessment findings with regard to Special Protection Areas. A summary of key assessment findings with regard to Special Areas of Conservation is provided in Chapter 9.

With regard to European Sites, a Screening assessment was carried out to provide the competent authority, with the information necessary to complete a Screening for Appropriate Assessment for the Proposed Development in compliance with Article 6(3) of the Habitats Directive. As part of this assessment, the potential for the Proposed Development to have an effect on any European sites in the likely Zone of Influence (ZOI) was considered. The Screening for Appropriate Assessment concluded that "*It cannot be excluded beyond reasonable scientific doubt, in view of best scientific knowledge on the basis of objective information and in light of the conservation objectives of the relevant European sites, that the Proposed Development, individually or in combination with other plans and projects, would have a significant effect on the following European Sites:*

- *Connemara Bog Complex SAC (002034)*
- *Lough Corrib SAC (000297)*
- *Ross Lake and Woods SAC (001312)*
- *Connemara Bog Complex SPA (004181)*
- *Lough Corrib SPA (004042)"*

The potential for effects to occur in relation to the above listed European sites has been considered as part of the Natura Impact Statement prepared for the Proposed Development. The findings presented in the NIS are that the Proposed Development, by itself or in combination with other plans and projects, in light of best scientific knowledge, will not adversely affect the integrity of the relevant European sites and no reasonable scientific doubt remains as to the absence of such effects.

10.6.2.2. Effects on Key Ornithological Receptors[15]

Table 10-18 provides a summary of effects and impact significance of the Proposed Development in comparison to the consented wind farm project during the construction phase. With regards to habitat loss, the Proposed Development will require the removal of c.2.45ha conifer plantation and c.0.72ha scrub.

[15] For avifauna receptor evaluation see Section 10.5.8

Table 10-18: Characterisation of effects on key ornithological receptors (Percival, 2003 and EPA, 2022)

Key Receptor (Sensitivity)	Characterisation of effect from proposed development	Significance without Mitigation
Common Gull (Very High)	This species was recorded on two occasions during VP surveys, both of the observations were of single birds. Twenty common gull were also recorded during the waterbird counts and fifteen were recorded during the hinterland surveys. Direct Habitat Loss There will be no loss of suitable habitat for this species. Potential effects with regard to direct habitat loss are not anticipated. Displacement Common Gull is not identified as a species which is particularly sensitive to wind energy development in Mc Guinness et. al. (2015). Very few observations of commuting birds were recorded. The proposed amendments will not result in significant adverse effects as a result of displacement.	Magnitude of effects is assessed as Negligible species sensitivity is Very High, overall effect significance is Low (Criteria: Percival, 2003). Long-term imperceptible impact (Criteria: EPA, 2022)
Cormorant (Very High)	Observations were mainly of single birds. The maximum count of birds was three during a hinterland survey undertaken in March 2023. The species was not recorded breeding on site. Direct Habitat Loss There will be no loss of suitable habitat for this species. Potential effects with regard to direct habitat loss are not anticipated. Displacement Cormorant is not identified as a species which is particularly sensitive to wind energy development in Mc Guinness et. al. (2015). Very few observations of commuting birds were recorded and the study area does not provide suitable foraging habitat for this species (i.e. lakes). The proposed amendments will not result in significant adverse effects as a result of displacement.	Magnitude of effects is assessed as Negligible species sensitivity is Very High, overall effect significance is Low (Criteria: Percival, 2003). Long-term imperceptible impact (Criteria: EPA, 2022)
Golden Plover (Very High)	This species was recorded on five occasions, with one of the observations outside of the viewshed. All of the observations occurred during winter months with four occurring during October 2022 and one in December 2022. The largest observed flock contained one hundred and eight birds, which were recorded flying and circling at a height of between 2 and 200m. Direct Habitat Loss There will be no loss of suitable habitat for this species. Potential effects with regard to direct habitat loss are not anticipated. Displacement Suitable breeding habitat is present within the EIAR study area, however, observations of Golden Plover during surveys undertaken to inform the Permitted Development and the Proposed Development were all recorded in winter or early spring; no evidence of breeding in the study area has been recorded. The proposed amendments are not anticipated to result in any changes that would result in significant adverse effects as a result of displacement.	Magnitude of effects is assessed as Negligible species sensitivity is Very High, overall effect significance is Low (Criteria: Percival, 2003). Long-term imperceptible impact (Criteria: EPA, 2022)
Grey Heron (Very High)	Grey heron was recorded on two occasions during VP surveys, both observations were of single birds. One grey heron was recorded during the waterbird counts and one grey heron was recorded standing in water during the hinterland surveys. Direct Habitat Loss There will be no loss of suitable habitat for this species. Potential effects with regard to direct habitat loss are not anticipated. Displacement Grey Heron is not identified as a species which is particularly sensitive to wind energy development in Mc Guinness et. al. (2015). Very few observations of commuting birds were recorded and the study area does not provide suitable foraging habitat for this species (i.e. larger rivers and lakes). The proposed amendments will not result in significant adverse effects as a result of displacement.	Magnitude of effects is assessed as Negligible species sensitivity is Very High, overall effect significance is Low (Criteria: Percival, 2003). Long-term imperceptible impact (Criteria: EPA, 2022)
Hen Harrier (Very High)	Single hen harriers were recorded on three occasions during the site surveys. This species was not recorded utilising habitat within the EIAR study area for roosting or breeding. Direct Habitat Loss Habitat loss will be limited to semi-mature/mature conifer plantation and scrub; direct loss of potential foraging habitat will be insignificant. Substantial areas of undisturbed suitable foraging habitat will remain at the EIAR study area and the surrounding landscape. Displacement No hen harrier breeding or roosting sites have been recorded in the study area. The proposed amendments are not likely to result in disturbance that would affect the breeding success, foraging or flight activity of this species. No significant adverse effects are anticipated.	Magnitude of effects is assessed as Negligible species sensitivity is Very High, overall effect significance is Low (Criteria: Percival, 2003). Long-term imperceptible impact (Criteria: EPA, 2022)

Kestrel (High)	Kestrel was recorded on a total of one hundred and twenty-nine occasions during the VP surveys, with most observations of single birds. This species was not recorded utilising habitat within the EIAR study area for roosting or breeding. Direct Habitat Loss Habitat loss will be limited to semi-mature/ mature conifer plantation and scrub. Commercial forestry and scrub does not provide optimal habitat for this species, however, potential nesting habitat is present within mature forestry trees. The felling of mature forestry trees may reduce the availability of potential nest sites, however significant areas of forestry edge will remain both within the EIAR study area and the wider landscape. There will be no loss of open grassland, heath and bog habitats which could potentially be used for foraging. Displacement The proposed amendments are not likely to result in disturbance that would affect the breeding success, foraging or flight activity of this species. No significant adverse effects are anticipated.	Magnitude of effects is assessed as Negligible species sensitivity is High, overall effect significance is Very Low (Criteria: Percival, 2003). Long-term imperceptible impact (Criteria: EPA, 2022)
Mallard (Very High)	Mallard was recorded on twelve occasions during the VP watches, this species was also recorded during waterbird counts, winter walkover survey and hinterland surveys. Direct Habitat Loss There will be no loss of suitable habitat for this species. Potential effects with regard to direct habitat loss are not anticipated. Displacement Mallard is not identified as a species which is particularly sensitive to wind energy development in Mc Guinness et. al. (2015). Relatively few observations of commuting birds were recorded and the study area does not provide suitable foraging habitat for this species (i.e. larger rivers, ponds and lakes). The proposed amendments will not result in significant adverse effects as a result of displacement.	Magnitude of effects is assessed as Negligible species sensitivity is Very High, overall effect significance is Low (Criteria: Percival, 2003). Long-term imperceptible impact (Criteria: EPA, 2022)
Mute Swan (Low)	No mute swan were recorded during the VP surveys, however this species was recorded during the waterbird survey and hinterland survey. Direct Habitat Loss There will be no loss of suitable habitat for this species. Potential effects with regard to direct habitat loss are not anticipated. Displacement Mute Swan is not identified as a species which is particularly sensitive to wind energy development in Mc Guinness et. al. (2015). No observations of commuting birds were recorded and the study area does not provide suitable foraging habitat for this species (i.e. larger rivers, ponds and lakes). The proposed amendments will not result in significant adverse effects as a result of displacement.	Magnitude of effects is assessed as Negligible species sensitivity is Low, overall effect significance is Very Low (Criteria: Percival, 2003). Long-term imperceptible impact (Criteria: EPA, 2022)
Peregrine Falcon (Very High)	During the VP surveys, peregrine falcon was observed on two occasions, both observations were of individual birds flying over bog habitats. No evidence of breeding Peregrine has been recorded during the surveys. Direct Habitat Loss There will be no loss of suitable breeding habitat onsite. There will be no loss of open grassland, heath and bog habitats which could potentially be used for foraging. Displacement The proposed amendments are not likely to result in disturbance that would affect the breeding success, foraging or flight activity of this species. No significant adverse effects are anticipated.	Magnitude of effects is assessed as Negligible species sensitivity is Very High, overall effect significance is Low (Criteria: Percival, 2003). Long-term imperceptible impact (Criteria: EPA, 2022)
Red Grouse (High)	Red grouse was observed on four occasions during VP surveys, this species was flushed out during the winter walkover surveys and fresh pellets were recorded, likely from a recent roost. Direct Habitat Loss There will be no loss of suitable habitat for this species. There will be no loss of foraging or breeding habitat for red grouse. Displacement This species has been recorded roosting within the study area. Populations of Red Grouse have been found to recover within one year after disturbance caused by construction of wind farms (Pearce-Higgins et al. 2012, cited in Mc Guinness et. al. (2015)). No significant adverse effects as a result of the proposed amendments are anticipated.	Magnitude of effects is assessed as Negligible species sensitivity is High, overall effect significance is Very Low (Criteria: Percival, 2003). Long-term imperceptible impact (Criteria: EPA, 2022)
Snipe (High)	Snipe was observed on fifteen occasions during VP surveys, predominantly perching or flying low over bog, grassland and moorland habitats. Snipe were also heard drumming (displaying) from VP1 indicating a breeding pair close by. Direct Habitat Loss There will be no loss of suitable habitat for this species. There will be no loss of foraging or breeding habitat for snipe. Displacement The proposed amendments are not likely to result in disturbance that would affect the breeding success or foraging activity of this species. No significant adverse effects are anticipated.	Magnitude of effects is assessed as Negligible species sensitivity is High, overall effect significance is Very Low (Criteria: Percival, 2003). Long-term imperceptible impact (Criteria: EPA, 2022)

Sparrowhawk (Low)	Sparrowhawk was observed on eight occasions during VP surveys, seven observations were of individual birds and one observation was of two birds (sex unknown) flying and hunting within forestry. No evidence of breeding sparrowhawk was recorded. Direct Habitat Loss Habitat loss will be limited to c.2.45ha conifer plantation (semi-mature/mature) and c.0.72ha scrub. The felling of mature forestry trees may reduce the availability of potential nest sites, however significant areas of forestry edge will remain both within the EIAR study area and the wider landscape. There will be no loss of open grassland, heath and bog habitats which could potentially be used for foraging. Displacement The proposed amendments are not likely to result in disturbance that would affect the breeding success, foraging or flight activity of this species. No significant adverse effects are anticipated.	Magnitude of effects is assessed as Negligible species sensitivity is Low, overall effect significance is Very Low (Criteria: Percival, 2003). Long-term imperceptible impact (Criteria: EPA, 2022)
Teal (Very High)	Teal was recorded on four occasions during the VP watches, this species was also recorded during waterbird counts and hinterland surveys. Direct Habitat Loss There will be no loss of suitable habitat for this species. Potential effects with regard to direct habitat loss are not anticipated. Displacement Teal is not identified as a species which is particularly sensitive to wind energy development in Mc Guinness et. al. (2015). Relatively few observations of commuting birds were recorded and the study area does not provide suitable foraging habitat for this species. The proposed amendments will not result in significant adverse effects as a result of displacement.	Magnitude of effects is assessed as Negligible species sensitivity is Very High, overall effect significance is Low (Criteria: Percival, 2003). Long-term imperceptible impact (Criteria: EPA, 2022)
White-tailed Eagle (High)	White-tailed Eagle was recorded on three occasions during VP surveys. No additional records of this species were recorded during surveys. No breeding or roosting sites were recorded within the study area. Direct Habitat Loss Habitat loss will be limited to conifer plantation (semi-mature/mature) and scrub. Commercial forestry and scrub habitats do not provide optimal habitat for this species. Substantial areas of undisturbed suitable foraging habitat will remain at the EIAR study area and the surrounding landscape. Displacement	Magnitude of effects is assessed as Negligible species sensitivity is High, overall effect significance is Very Low (Criteria: Percival, 2003). Long-term imperceptible
	Very few observations of commuting birds were recorded and there is no evidence that the study area is situated within an important commuting route for white-tailed eagle. The proposed amendments are not likely to result in disturbance that would affect the breeding success, foraging or flight activity of this species. No significant adverse effects are anticipated.	impact (Criteria: EPA, 2022)
Whooper Swan (Medium)	Whooper swan was recorded on one occasion during VP surveys. Four observations of whooper swan were also made during the waterbird counts. Direct Habitat Loss There will be no loss of suitable habitat for this species. Displacement Very few records of commuting birds were recorded (1 no.) and there is no evidence to suggest that the development site lies on a migratory route for the species. Therefore, significant displacement effects are not expected. No significant adverse effects are anticipated.	Magnitude of effects is assessed as Negligible species sensitivity is Medium, overall effect significance is Very Low (Criteria: Percival, 2003). Long-term imperceptible impact (Criteria: EPA, 2022)

10.6.3. Assessment of Effects During Operation

10.6.3.1. Effects on Designated Sites

The potential for effects to occur in relation to the above listed European sites has been considered as part of the Natura Impact Statement prepared for the Proposed Development. The findings presented in the NIS are that the Proposed Development, by itself or in combination with other plans and projects, in light of best scientific knowledge, will not adversely affect the integrity of the relevant European sites and no reasonable scientific doubt remains as to the absence of such effects.

10.6.3.2. Effects on Key Ornithological Receptors

The potential effects of the Proposed Development on avifauna during the operational phase relate to the risk of adverse effects due to the increase in tip height from a maximum of 140.5m to 150m.

As noted by Mc Guinness et. al. (2015), the main impacts of wind energy developments on birds are generally via four main categories; collision, disturbance displacement, habitat loss or damage and barrier effects.

Recent studies that have shown that mortality rate and collision risk were not significantly related to turbine size (Everaert, 2014) and the modern, larger turbines show comparable fatality estimates with earlier generation turbines, and much lower than may be expected based on the large rotor surface and high altitude range of modern larger turbines, possibly due to increased altitude, increased distance between turbines and slower rotation speeds (Krijgsveld et al., 2009).

Collision Risk

Raptors

Surveys undertaken to inform the EIS for the Permitted Development recorded kestrel and sparrowhawk within the study area and the collision risk for these species was assessed as being low. Kestrel and sparrowhawk were recorded within the study area during surveys undertaken in 2022/ 2023; infrequent observations of white-tailed eagle, hen harrier and peregrine falcon were also recorded.

The collision risk for Kestrel for the Proposed Development has been calculated (see Appendix 10.3) at a ratio of 7.02 per year for the Vestas 136 candidate turbine and 7.13 for the Enercon 138 candidate turbine. The magnitude of the effect is assessed as low. The cross tablature (in accordance with Table 10-4) of High Sensitivity species and Low Impact corresponds to a Low effect significance. This is considered to represent a long term moderate adverse effect on the local population of Kestrel.

The collision risk for Sparrowhawk has been calculated at a ratio of 0.04 per year for each turbine option. The magnitude of effect is assessed as negligible. The cross tablature of Low Sensitivity species and Negligible Impact corresponds to a Very Low effect significance. No significant effects are anticipated regarding collision risk at any geographical scale. This is considered to represent a long term imperceptible adverse effect.

The collision risk for White-tailed Eagle has been calculated at a ratio of 0.017 per year for each turbine option. The magnitude of effect is assessed as negligible. The cross tablature of High Sensitivity species and Negligible Impact corresponds to a Low effect significance. No significant effects are anticipated regarding collision risk at any geographical scale. This is considered to represent a long term imperceptible adverse effect.

The collision risk for Hen Harrier has been calculated at a ratio of 0.001 per year for both turbine options. The magnitude of effect is assessed as negligible. The cross tablature of Very High Sensitivity species and Negligible Impact corresponds to a Low effect significance. No significant effects are anticipated regarding collision risk at any geographical scale. This is considered to represent a long term imperceptible adverse effect.

The collision risk for Peregrine Falcon has been calculated at a ratio of 0.02 per year for both turbine options. The magnitude of effect is assessed as negligible. The cross tablature of Very High Sensitivity species and Negligible Impact corresponds to a Low effect significance. No significant effects are anticipated regarding collision risk at any geographical scale. This is considered to represent a long term imperceptible adverse effect.

Non-raptors

During the VP surveys, snipe was observed on fifteen occasions, predominantly perching or flying low over bog, grassland and moorland habitats. During the VP surveys, red grouse was observed on four occasions, none of which were within the potential collision risk height (PCH). Red grouse are largely sedentary and both red grouse and snipe are low flying species.

During the VP surveys, golden plover was recorded on five occasions. One of the observations of Golden Plover was not within the viewshed. All of the observations occurred during winter months with four occurring during October 2022 and one in December 2022. The largest observed flock contained one hundred and eight birds, which were recorded flying and circling at a height of between 2 and 200m. Four of the observed flights occurred within the potential collision risk zone. As noted in the EIS for the Permitted Development, there is no evidence of breeding golden plover at the site or the region. There is no recorded golden plover traditional over-wintering or feeding areas at, or in the vicinity of the site as evidenced from the bird surveys undertaken within the EIAR study area or other wind farms in the surrounding area (e.g. Ardderroo Wind Farm, Galway Wind Park, see Section 10.9.1 for further details in relation to cumulative impacts). The collision risk for Golden Plover has been calculated at a ratio of 21.5 per year for the proposed Vestas V136 candidate turbine and 21.8 per year for the proposed Enercon 138 candidate turbine. This collision risk assessment has applied a precautionary approach and includes flights up to 500m from the proposed turbine locations, as such the assessment is highly conservative, In accordance with Percival (2003), the magnitude of effect is assessed as low. The cross tablature of Very High Sensitivity species and Low Impact corresponds to a Medium effect significance. This is considered to represent a long term moderate adverse effect on the local population of Golden Plover.

The remaining non-raptor target species were recorded infrequently during the VP surveys. Whooper swan was recorded on one occasion; five birds were recorded at VP 2 flying and calling at a height of between 50 and 180m (i.e., within the potential collision risk zone). Cormorant was recorded on three occasions, all three of the observations were of single birds flying within the potential collision risk height. Grey heron was recorded on two occasions, both of the observations were of single birds, flying within the potential collision risk zone. Common gull was recorded on two occasions, both of the observations were of single birds, one of which was flying within the potential collision risk zone and one was flying below the potential collision risk zone. No mute swan were recorded during the VP surveys. A low collision risk for these species has been calculated (see Appendix 10.3). Mallard was recorded on twelve occasions, all twelve of the observations were of birds flying under the potential collision risk zone. Teal was recorded on four occasions during the VP watches. Three of the observations were of birds flying under the potential collision risk zone and one was an auditory record. As such, the collision risk for Mallard and Teal at the proposed site is zero.

The EIS for the Permitted Development assessed the collision risk for birds of prey as being low; red grouse negligible; snipe low, golden plover, whooper swan, teal, cormorant and little grebe as being low.

In view of the results of the collision risk modelling for the Proposed Development, as described above and included in Appendix 10.3, it is concluded that the Proposed Development will not result in any changes that would result in significant adverse effects on key ornithological receptors as a result of collision risk.

Disturbance Displacement

The Proposed Development will not result in any changes that would affect key ornithological receptors as a result of disturbance/ displacement.

No significant adverse effects are anticipated.

Habitat Loss or Damage

The Proposed Development will not result in any changes that would affect key ornithological receptors as a result of habitat loss.

No significant adverse effects are anticipated.

Barrier Effects

As noted in the EIS for the Consented Development, Cnoc Raithní wind farm consists of 11 turbines laid out in a cluster arrangement, turbines are widely spaced and ample flight corridors exist between turbines. The Proposed Development will not result in any changes to the location of turbines and will not introduce any barriers to the movement of avifauna within the study area. No significant adverse effects are anticipated.

10.6.4. Decommissioning Phase

No new impacts will arise on avifauna during the decommissioning phase of the project.

10.7. Mitigation Measures and Monitoring

10.7.1. Construction Phase

All construction phase mitigation for avifauna will be implemented as set out in the EIS for the Permitted Development to include:

- Implementation of a Red Grouse Management Plan, including the requirement for an ecological officer (also referred to as an Ecological Clerk of Works) to monitor construction phase;
- The felling of conifers should take place outside the breeding bird season, if possible;
- Implementation of habitat restoration measures to offset any habitat loss;
- Minimizing damage or loss of wet heath/ blanket bog habitats during construction phase through demarcation of site and restriction of access outside of this. Machinery to be kept on roads and hardstanding areas.
- Agreed bird monitoring programme to be implemented to include vantage point surveys, Red Grouse survey and breeding bird transects.

The Proposed Development does not present likely significant effects on ornithological receptors. No further specific mitigation measures are required.

10.7.2. Operational Phase

All operational phase mitigation and monitoring for avifauna will be implemented as set out in the EIS for the Permitted Development to monitor any residual unpredicted impacts on birds, as well as the effectiveness of the mitigation measures. As set out in the EIS for the Permitted Development, bird surveys should include:

- Winter and summer vantage point surveys;
- Merlin surveys;
- Breeding transect surveys; and
- Red Grouse surveys.

Further to the above requirements Flight Activity Survey (to be conducted during years 1, 2, 3, 5, 10 and 15 post construction) shall be undertaken during the summer and winter months to include both Vantage Point and hinterland surveys as Per SNH (2017) guidance to:

- Record any barrier effect i.e., the degree of avoidance exhibited by species approaching or within the wind farm. Target species to be as defined in Section 10.4 of this report; and
- Record changes in flight heights of key receptors post construction.

Fatality Monitoring

A comprehensive fatality monitoring programme shall be undertaken during years 1, 2, 3, 5, 10 and 15 post construction following published best practice. The primary components are as follows:

- Initial carcass removal trials to establish levels of predator removal of possible fatalities. This will be done following best recommended practice and with due cognisance to published effects such as predator swamping, whereby excessive placement of carcasses increases predator presence and consequently skews results (Shawn et al., 2010). No turbines which are used for carcass removal trials are to be used for subsequent fatality monitoring. Carcass removal trials shall be continued for the duration of fatality searches;
- Turbine searches for fatalities are to be undertaken following best practice in terms of search area (minimum radius hub height = 150m around turbine bases) and at intervals selected to effectively sample fatality rates based on carcass removal rates (e.g., 1 per month). To be conducted during years 1, 2, 3, 5, 10 and 15 post construction to allow for annual variation and cumulative effects. Dependent on results further monitoring to be agreed with NPWS;
- A standardised approach with a possible control group and/or variation in search techniques such as straight line transects/ randomly selected spiral transects/ dog searches will be undertaken. This will provide a means of robustly estimating the post construction collision fatality impact (if any); and
- Recorded fatalities to be calibrated against known predator removal rates to provide an estimate of overall fatality rates.

10.8. Residual Effects

10.8.1. Construction Phase

No significant residual impacts on avifauna are anticipated as a result of the Proposed Development during the construction phase.

10.8.2. Operational Phase

As detailed in Section 10.7.2, a comprehensive monitoring program will also be implemented following construction of the proposed wind farm; this will monitor the degree of barrier effect, if any, on existing species as a result of the development, in addition to comprehensively monitoring any bird fatalities.

It is considered that with the implementation of mitigation, the Proposed Development will have a Slight-Imperceptible Residual Impact on birds.

10.8.1. Decommissioning Phase

No significant residual impacts on avifauna are anticipated as a result of the Proposed Development during the decommissioning phase.

10.9. Cumulative Effects

In accordance with CIEEM (2018), cumulative impacts and effects from two or more developments may be:

- Additive/incremental – multiple activities/projects (each with potentially insignificant effects) added together to give rise to a significant effect due to their proximity in time and space. The effect may be additive (1+1 = 2) or synergistic (1+1 = 3).
- Associated/connected – a development activity enables another development activity e.g. phased development as part of separate planning applications. Associated developments may include different aspects of the project which may be authorised under different consent processes.

Details on projects considered in this assessment are provided in Section 1.10 of this EIAR (Section 1 Introduction).

10.9.1. Other Wind Farm Developments

10.9.1.1. Ardderroo Wind Farm (overlaps the Proposed Development)

The following species were identified as KORs and were subject to detailed impact assessment:

- Golden Plover (Annex I species and SCI of nearby SPAs)
- Cormorant (Annex I species and SCI of nearby SPA)
- Common Gull (SCI of nearby SPAs)
- Whooper Swan (Annex I species)
- White-tailed Eagle (Annex I Species)
- Hen Harrier (Annex I species and SCI of nearby SPA)
- Merlin (Annex I species and SCI of nearby SPA)
- Red Grouse (Red listed species in breeding season)
- Woodcock (Red listed species in breeding season)
- Kestrel (Schedule 4 of the Wildlife Act; 1976)
- Sparrowhawk (Schedule 4 of the Wildlife Act; 1976)

As per Percival 2003 criteria, effect significance of greater than Low was not identified for any KOR. As per EPA 2017 criteria, effect significance of greater than Slight was not identified for any KOR.

Taking into consideration the effect significance levels identified and the proposed best practice and mitigation; the EIAR concluded that significant residual effects on KORs with regard to direct habitat loss, displacement or collision mortality are not anticipated.

10.9.1.2. Galway Wind Park Cloosh (4.3km west) (overall 69 turbines consented and 60 constructed)

Surveys were carried out in two stages: 2005/06 and 2008/09. Sixty-one bird species were recorded. Two BoCCI Red listed species were recorded: Golden Plover and Red Grouse.

Six Annex I bird species were recorded: Greenland White-fronted Goose, Golden Plover, Hen Harrier, Merlin, Peregrine Falcon and Whooper Swan. No evidence of breeding Hen Harrier was recorded although the species visited the site occasionally during the winter period. Whooper Swan were recorded from lakes near the site with very few flights over the site observed. Seecon Lake appeared to be of greatest significance to the species. Golden Plover was never recorded flying over the site. Red Grouse was not recorded from within the site boundary. Peregrine was regularly recorded in the winter months. Only incidental sightings of Merlin were recorded. Greenland White fronted Goose did not utilise the development site due to lack of suitable habitat but a number of flight lines were recorded in September and October. Flights were very high and above the potential collision risk height.

No significant residual impacts on birds were identified.

10.9.1.3. Galway Wind Park Uggool (2.6km northwest)

No Annex species or I species listed on the BoCCI Red list were recorded during surveys undertaken to inform the EIS submitted in 2003. As part of a proposed redesign of the wind farm additional survey were undertaken to accompany an application in 2011.

Three Annex I bird species were recorded:

- Incidental sightings of Merlin recorded but no breeding evidence observed
- Whooper swans were recorded on three occasions on Glen Lough. Maximum numbers recorded was five. Five Whooper Swan were recorded at Seecon Lough.
- A casual observation of a single White-tailed Eagle was made to the north of the site in January 2011.

Red Grouse was the only red listed species recorded.

No significant residual effects on avian receptors were identified.

10.9.1.4. Galway Wind Park Seecon (5.2km southwest)

The red listed species Red Grouse and Golden plover were recorded near the site.

Five Annex I bird species were recorded:

- Greenland White Fronted Geese were recorded near the site but were not recorded using or flying over the site.
- Whooper Swan were recorded on three lakes: Seecon Lough, Lettercraggroe and Aclogher Lake (maximum of 6 no. recorded).
- Merlin was recorded on two occasions during winter VP surveys
- Golden plover was heard on four occasions during VP surveys but was not observed.
- White Tailed Eagle were recorded on two occasions: a single bird recorded to the north of the site and a pair of eagles were observed flying over the northeastern part of the site.

10.9.1.5. Lettercraffroe (7.3km northwest)

The red listed species Red Grouse and Golden plover were recorded. Cormorant was observed outside the site. Four Annex I species were recorded:

- Merlin were not recorded during the breeding season. Two sightings were recorded during the winter season.
- Golden Plover was recorded outside the site, but not within the site boundary. Flocks were recorded in November 2009 and in March 2010. Max flock size was 160. Flocks were recorded flying over areas of upland blanket bog.
- Whooper Swan were recorded in the winter season (maximum of 4 no. from Seecon Lough and Lettercraffroe).
- Two immature tagged White-tailed Eagles from the Killarney introduction project were observed at the edge of Lettercraffroe Lough in May 2010.

No significant residual effects on avian receptors were identified.

10.9.1.6. Knockalough Wind Farm (3km south)

Golden Plover were not recorded within the site although small numbers are present in the wider area. Single male Hen Harrier were recorded on two occasions. Red Grouse were not recorded within the study area.

No significant residual effects on avian receptors were identified.

10.9.1.7. Leitir Gungaid (Lettergunnet) (6.9km south-southeast)

Small flocks of wintering Golden Plover were recorded in the vicinity of the study area and two pairs of Red Grouse were recorded at the site.

No significant residual effects on avian receptors were identified.

10.9.1.8. Letterpeck (Shannagurran & Truskaunngappul) (5.3km south)

Small flocks of wintering Golden Plover were recorded in the vicinity of the study area and two pairs of Red Grouse were recorded near the eastern boundary of the site.

No significant residual effects on avian receptors were identified.

10.9.2. Other Projects (non-wind farm)

Other notable projects include the proposed N59 Maigh Cuilinn (Moycullen) Bypass Road Project, currently under construction, and the Connemara Greenway, which received permission from An Bord Pleanála in 2013, and identified domestic and agricultural projects. No potential for significant cumulative impacts with these projects has been identified.

Other activities in the area of the Proposed Development include felling operations, which include a Coillte felling programme in operation in the area. Coillte also propose to fell forestry within the Ardderroo Wind Farm boundary as part of a bog restoration plan, subject to licensing. Felling operations are subject to Appropriate Assessment and are required to be undertaken in accordance with Standards for Felling and Reforestation (DAFM, 2019). No potential for significant cumulative impacts with these projects has been identified.

10.9.3. Assessment of Cumulative Effects

The species assemblages and level of recorded activity for nearby wind farm developments as listed above are broadly similar to that recorded at the proposed site at Cnoc Raithní.

No potentially significant residual effects in relation to collision risk, disturbance, displacement, habitat loss or barrier effects were reported for any ornithological receptors within any of the nearby windfarm developments reviewed. It is noted that 60 of the permitted 69 turbines at Galway Wind Park (GWP) have been constructed. Any further development at GWP will be subject to mitigation measures conditioned as part of the Permitted Development.

No potentially significant cumulative collision risk, disturbance, displacement or habitat loss effects on any of the key ornithological receptors has been identified with regard to the Proposed Development.

Taking into consideration the reported residual effects from other plans and projects in the area and the predicted residual effects of the Proposed Development at Cnoc Raithní, no residual cumulative and/or in combination effects have been identified with regard to avifaunal features either in isolation or cumulatively with other projects.

10.10. Difficulties Encountered in Compiling Information

No difficulties were encountered in compiling the information contained in this assessment.

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CNOC RAITHNÍ (KNOCKRANNY) WIND FARM

CHAPTER 11

Archaeology and Cultural Heritage

VOLUME II EIAR

CHAPTER 11 – Cultural Heritage

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Chapter 11

11. ARCHAEOLOGY & CULTURAL HERITAGE

11.1. Introduction

This chapter presents the results of an archaeological and cultural heritage impact assessment of the Proposed Development comprising of amendments to the permitted Cnoc Raithni (Knockranny) Wind Farm Project. A detailed description of the Proposed Development is provided in Chapter 2 of this EIAR.

The report combines desk-based research of the available cultural heritage and archaeological data, inclusive of the assessment undertaken in Chapter 14 (Archaeology and Cultural Heritage) of the Permitted Development I EIS (Rubicon Heritage, 2013). This was supplemented by site survey of the proposed electrical and communications cabling route from the 11 no. turbines to the existing Ardderroo substation.

11.2. Assessment Methodology

The chapter was completed using desk-based assessment of all available archaeological, historical, cultural and cartographic sources. The desk-based assessment is defined as a program of study of the historic environment within a specified area or site that addresses agreed research and / or conservation objectives.

The primary EIAR study area comprises of the northwest limits of Knockranny townland within which the permitted Knockranny wind farm is located (Figure 11.1). In that context, a c.5km study area from the Proposed Development was established and archaeologically assessed (Figure 11.2). In a wider study context, recorded National Monuments in State Care were assessed within c.10km from the limits of the proposed development. The study limits of the proposed underground electrical and communications cabling connecting the 11 no. wind turbines to the Ardderroo substation comprised of an assessment of potential impacts within a 100m wide corridor between Ardderroo substation and the permitted Knockranny wind farm within Letter and Ardderroo townlands. A walkover survey of this cabling route was conducted in April 2023 to assess the potential for impacts arising from the proposed laying of cabling in existing, new and widened access tracks as described in Chapter 2.

Comprehensive research was undertaken including several published and unpublished documentary sources were examined including:

11.2.1. Documentary sources

11.2.1.1. Sites and Monuments Records / Record of Monuments and Places

The Sites and Monuments Records (SMR) / Record of Monuments and Places (RMP) compiled by the Archaeological Survey of Ireland of the National Monuments Service (NMS) comprises lists, classifications of monuments and maps of all recorded monuments with known locations and zones of archaeological notification. The monuments records are searchable online from the NMS at (www.archaeology.ie) and was assessed in February 2023.

11.2.1.2. National Monuments in State Care Database

This is a list of all the National Monuments in the State guardianship or ownership where each monument is assigned a National Monument number whether in guardianship or ownership and has a brief description. A National Monument receives statutory protection and is described as '*a monument or the remains of a monument the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto*' (National Monuments Act, 1930, Section 2). The National Monuments legislation legally protects access to, and the visual amenity associated with National Monuments and requires consent from the Minister for invasive works in their vicinity.

11.2.1.3. National Inventory of Architectural Heritage & Recorded Protected Structures

The NIAH was established under the provisions of the Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act 1999. It is a government-based organization tasked with making a nationwide record of locally, regionally, nationally and internationally significant structures dating to post-1700 AD, which in turn provides county councils with a guide as to what structures to list within the Record of Protected Structures (RPS). A protected structure is a structure that is considered to be of '*special interest*', which is broadly defined by the Planning and Development Act, 2000 as structures of architectural historical, archaeological, artistic, cultural, scientific, social or technical point interest. The 2000 Act requires each planning authority to compile and maintain an RPS. The RPS is a mechanism for the statutory protection of the architectural heritage and is listed in every County Development Plan and Town Development Plan (see below). Only those structures of regional importance or above are included in the Minister's recommendations for inclusion in the RPS.

The NIAH have also carried out a nationwide desk-based survey of historic gardens, including demesnes that surround large houses.

11.2.1.4. Galway County Development Plan

The Galway County Development Plan (2022-2028) Chapter 12 (Architectural, Archaeological and Cultural Heritage), list of Record Protected Structures (Appendix 6), and list of Architectural Conservation Areas (Appendix 7) within the county were also examined.

11.2.1.5. Topographic Files of the National Museum of Ireland

The National Museum of Ireland (NMI) Topographic Files of artefacts found in Ireland by townland were examined as well as the online searchable browser database of artefacts on the Heritage Maps produced by the Heritage Council, www.heritagemaps.ie.

11.2.1.6. Excavations Bulletin

The Excavations Bulletin and its online database which contains summaries of all archaeological excavations carried out in Ireland, was assessed in February 2023 (www.excavations.ie).

11.2.1.7. Placename Studies

Placenames (*logainmneacha*) are an important aspect of understanding the history and topography of a location particularly when used in association with the Ordnance Survey Name Books (OSNB). The general or baseline placename research source is an online GIS portal which was accessed in February 2023 (www.logainm.ie).

11.2.2. Cartography

Several historic maps were examined including the Down survey maps of between 1650-1670 and the 19th / 20th century Ordnance Survey Maps.

11.2.3. Aerial Photography

A variety of aerial photography was examined including aerial orthophotos from the National Monuments Service and Ordnance Survey websites.

11.2.4. Conventions, Legislation and Guidelines

This Chapter was also undertaken with due regard to the following national and international protective conventions, legislation and guidelines and legislation:

- National Monument Act, 1930 to 2014.
- Heritage Act, 1995, as amended
- European Convention on the Protection of the Archaeological Heritage (the 'Valletta Convention') ratified by Ireland in 1997.
- Council of Europe Convention on the Protection of the Architectural Heritage of Europe (the 'Granada Convention') ratified by Ireland in 1997.
- Framework and Principles for the Protection of the Archaeological Heritage, 1999, Department of Arts, Heritage, Gaeltacht and the Islands.
- The Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous) Provisions Act, 1999, as amended.
- The conservation principles as set out by International Council on Monuments and Sites (ICOMOS) in the Venice and Burra Charters.
- Planning and Development Act, 2000, as amended.
- Architectural Heritage Protection-Guidelines for Planners by the Department of the Environment Heritage and Local Government 2011 (DoEHLG).
- The Architectural and Archaeological Heritage Objectives as detailed in Draft County Galway Development Plan 2022-2028.
- The Advice Series-A Guide to the Care of Older Buildings published by the Architectural Heritage Advisory Unit of the DoEHLG, 2007-2011.
- The Handbook of the National Inventory of Architectural Heritage (NIAH) of September 2017.

11.3. Baseline Conditions

11.3.1. Existing Receiving Environment

The permitted wind farm development occupies townland of Knockranny in the Barony of Moycullen, in the County of Galway. There is one National Monument within 10km radius study zone, four recorded monuments within the EIAR study area (and Knockranny townland itself) including one within the planning boundary of the Proposed Development (Figure 11.1). In the wider *c*.5km study zone there are over eighty recorded monuments (Figure 11.2, Table 11.1). Nineteen century farming landscape is well-preserved within the EIAR study area with two farm clusters at *Cloghvally* (West and Southwest limits) and second settlement at Northeast. These settlements are characteristic for this upland part of Connemara and at least 40 have been identified within the vicinity of the Project (Grogan, 2013, Rubicon 2013).

The proposed underground electrical and communications cabling connecting the 11 no. wind turbines to the Ardderroo substation will traverse southeast from the Ardderroo Substation at Letter townland next it will turn south reaching Ardderroo townland and finally turning east to connect with the proposed wind farm at Knockranny. Part of the underground cabling will traverse in a widened access road, part in an existing road, and the east-west section in a new service tracks.

- New access track area: This area is mixed with boulders and some low-lying scrub. Most of the route has been disturbed by road building and previous works.
- Existing access road: The section of the route travels along the existing road which services part of the Ardderroo wind farm and was upgraded as part of this.
- The final section of the route is a proposed widening of the existing road to the south. This road is in use as an access track to turbary. The area to be widened is largely on the margins of cutaway bog.

There are no recorded monuments in the area of the proposed ducting route and no previously unrecorded archaeological features or finds were noted during the walkover survey.

11.3.1.1. National Monuments in State Ownership / Guardianship

There are no National Monuments in State Ownership/ Guardianship within the EIAR study area. There is one National Monuments in State Ownership situated within the 10km wider study area of the Proposed Development. It is Aughnanure Castle GA054-002 (NMN 470) located *c*.7km to the north of the proposed turbines.

The following description is provided for Aughnanure Castle from the National Monument Database (www.archaeology.ie): '*On a natural rock outcrop on S bank of Drimneen River close to its outflow into Lough Corrib. This Nat. Mon. consists of a 16th -17th -C tower house enclosed by two bawns: a large, irregular outer bawn (46m by 49m), lying to S and E of the tower house, is defended by five turrets. The remains of a rectangular banqueting hall (L 24m, Wth >7m) stand in its SW corner. The earlier, wedge-shaped inner bawn (36m by 22m max.) sits on the rock outcrop and was defended by a drawbridge, gun loops and a circular turret at SE corner, the latter later reused as a dovecote. Centrally placed in the inner bawn is the conserved, rectangular tower house (L 12.2m, Wth 8.7m) of seven storeys, built in two phases. The doorway, in E wall, gives access to a lobby with murder-hole above, and spiral stairs in SE corner. The ground and upper floors each comprise a main chamber with a subsidiary one to E. Stone vaults exist between ground/1st and 3rd/4th floors. There is a fireplace on 4th floor in S wall and latrines on 1st and 4th floors: a trapdoor in the latter gives access to a concealed chamber below it in the thickness of the arch. There are bartizans at SE and NE corners on 2nd floor and a centrally placed machicolation on each wall at parapet level. Much of the latter, and the 7th-storey gabled garret, are reconstructions. There are single-light ogee-headed windows and later twin-light flat-headed windows, with hood-mouldings, in tower: one of the two surviving windows in the banqueting hall has finely decorated soffits" (Leask 1951, 106). (OPW 1980; Fleming 1909, 180-2; Killanin 1947, 124, 129)'.*

11.3.1.2. Recorded Monuments within EIAR study area

Examination of the Sites and Monuments Records (SMR) / Record of Monuments and Places (RMP) revealed that there are four recorded monuments in total within EIAR study area one of which (Children's burial ground, GA067-033), is located east of T6(Figure 11.1). The three other recorded monuments are: hut site (GA067-032), cairn (GA067-029) and cist (GA057-029001, latter as described under GA067-029).

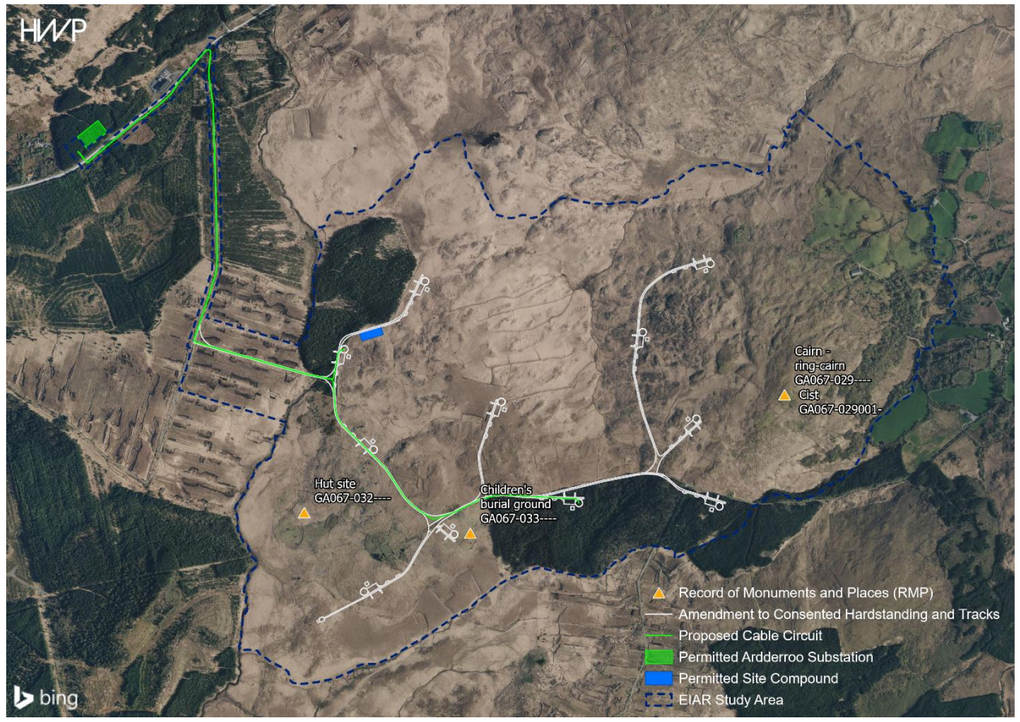

Figure 11.1 Wind farm layout with recorded monuments within EIAR study area

The location of the children's burial ground (GA067-033) was established based on local information. The National Monument Service Database states: *'According to local information a possible children's burial ground was located somewhere within the area of the four fields indicated at this location on the OS 6-inch map. There is no visible surface trace of any burial markers in these fields and the co-ordinates for this record can only be considered as indicative of the area where the burial ground was reportedly located '*(www.archaeology.ie). The possible children's burial ground is located in vicinity of Turbine 6 south of exiting access road. There is no visible trace of any features that can be associated with the burial ground (an enclosure, raise burial area or stone markers) of it over surface (Rubicon Heritage 2013, p.6)

Recorded hut site (GA067-032) is situated c.600m west of the children's burial ground. It is described in the National Monument Service Database as*: 'The remains of this possible hut site consist of a C-shaped low earthen bank (max. external dimensions 7.2m N-S x 9.5m E-W: H 0.3m), with some possible stone revetting at SE corner on the outer edge of the bank. There is a break in the bank at W that is partly obstructed by an irregularly shaped low mound (2m N-S x 2.5m E-W)* (Ibid).'

Recorded Cairn (GA067-029) and cist (GA067-029001) are situated at eastern limits of EIAR study area. The National Monument Service Database states: *'On the summit of Knockranny, a locally prominent steep-sided hill. This small low circular ring-cairn (overall diam. c. 11m) is defined by a grassy bank externally and a ragged stony scarp internally. There is a narrow gap (Wth 0.5m) at NNW. The interior is slightly dished in profile, but it is partially obscured by a modern drystone-built cairn (H 1m; diam. 2.3m) which occupies the center of the monument. A possible cist (GA057-029001-) is visible in the SSE sector' (pers. comm. P. Gosling 2013)* (Ibid)'.

11.3.1.3. Recorded monuments within 5km study area

There are eighty-five recorded monuments located in wider, 5km radius study zone (Figure 11.2, Table 11.1). This 5km radius study zone was undertaken for the purposes of assessing potential cultural visual impact in the wider landscape setting. Four of the recorded monuments are located within EIAR study area and are described above. Ten monuments which are classified as redundant records are not included in this assessment.

The recorded monuments are dated from prehistoric period through medieval to post-medieval times. They are listed in Table 11.1 and discussed below.

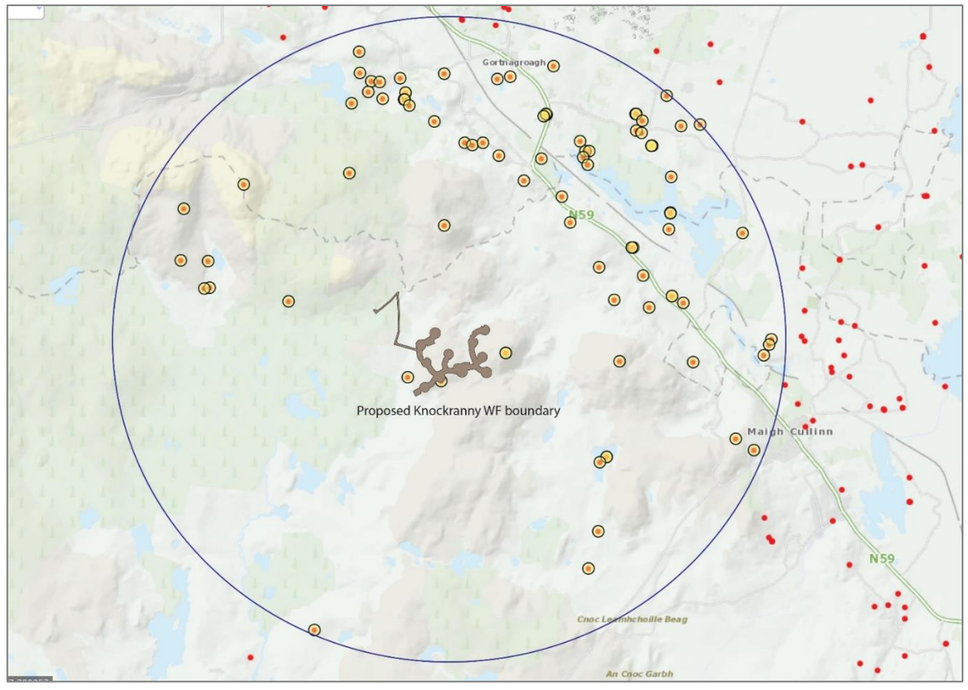

Figure 11.2 Recorded monuments within wider *c.*5km study area

SMR No.	Class	Townland	ITM (E)	ITM (N)
GA054-062----	Cairn - unclassified	RAHA	513815	739315
GA067-001----	Enclosure	CARROWNDULLA	513834	738950
GA067-004----	Enclosure	CARROWNDULLA	514529	738847

GA067-005----	Mill - corn	CARROWNDULLA	514234	738496
GA067-006----	Enclosure	CARROWNDULLA	513971	738612
GA067-007----	Designed landscape feature	DOON (Moycullen By.)	515656	737730
GA067-008----	Designed landscape feature	DOON (Moycullen By.)	515786	737689
GA067-009----	Ringfort - cashel	DOON (Moycullen By.)	515971	737728
GA067-010----	Designed landscape feature	DOON (Moycullen By.)	516252	737506
GA067-011----	Crannog	GORTACARNAUN (Moycullen By.)	516230	738835
GA067-014----	Ringfort - unclassified	GORTNAGROAGH	516455	738884
GA067-015----	Graveyard	KILLAGUILE	515300	738931
GA067-016----	Ringfort - cashel	KILLAGUILE	514618	738604
GA067-016001-	House - indeterminate date	KILLAGUILE	514618	738604
GA067-017001-	Ritual site - holy well	KILLAGUILE	514593	738482
GA067-017002-	Penitential station	KILLAGUILE	514605	738483
GA067-018----	Children's burial ground	KILLAGUILE	514695	738371
GA067-019----	Enclosure	KILLAGUILE	515129	738097
GA067-021----	Enclosure	LEITIR	512586	734957
GA067-023----	Sheepfold	OGÚIL	511180	735665
GA067-025----	Cairn - unclassified	DERRYVOGHIL, OGÚIL	511811	737005
GA067-027----	Kiln - lime	BUFFY	513690	738416
GA067-028----	Standing stone	OGÚIL	511207	735198
GA067-029----	Cairn - ring-cairn	CNOC RAITHNÍ	516370	734066
GA067-029001-	Cist	CNOC RAITHNÍ	516370	734066
GA067-030----	Cairn - unclassified	KILLAGUILE	513640	737199
GA067-031----	Cairn - unclassified	DOON (Moycullen By.)	515302	736290
GA067-032----	Hut site	CNOC RAITHNÍ	514660	733646
GA067-033----	Children's burial ground	CNOC RAITHNÍ	515251	733573
GA067-034----	Kiln - corn-drying	OGÚIL	510710	735679
GA067-035----	Kiln - corn-drying	OGÚIL	511115	735187
GA067-036----	Sheepfold	OGÚIL	510758	736580
GA068-005001-	Church	BOLEYVAUNAUN	518646	737943
GA068-005002-	Bullaun stone	BOLEYVAUNAUN	518738	737902
GA068-009----	Children's burial ground	CÚÍL EACH (Bar. Maigh Cuillinn)	518587	735907
GA068-009001-	Bullaun stone	CÚÍL EACH (Bar. Maigh Cuillinn)	518566	735906
GA068-010----	Enclosure	DOON (Moycullen By.)	516690	737070
GA068-012001-	Church	PÁIRC NA gCOLM	519273	735054
GA068-012002-	Ecclesiastical enclosure	PÁIRC NA gCOLM	519268	735062
GA068-013----	Country house	PÁIRC NA gCOLM	519470	734938

GA068-014----	Ringfort - unclassified	GARRYNAGRY	519179	738553
GA068-015----	Enclosure	GARRYNAGRY	518636	738236
GA068-015001-	Church	GARRYNAGRY	518649	738231
GA068-021----	Building	GORTNAMONA EAST	519635	733899
GA068-024----	Church	KILLANNIN	518921	737676
GA068-024001-	Graveyard	KILLANNIN	518912	737671
GA068-024002-	Cross-slab	KILLANNIN	518913	737670
GA068-025----	Ritual site - holy well	KILLANNIN	519248	737128
GA068-028----	Quarry	CNOCÁN RAITHNÍ	517999	735558
GA068-029----	Enclosure	CNOCÁN RAITHNÍ	517494	736343
GA068-031----	Castle - unclassified	AN CNOC BÁN	519242	736506
GA068-031001-	Crannog	AN CNOC BÁN	519242	736495
GA068-032----	Enclosure	AN CNOC BÁN	519210	736214
GA068-033----	Enclosure	CNOC AN tSEANBHAILE	520874	734025
GA068-034----	Children's burial ground	CNOC AN tSEANBHAILE	520998	734307
GA068-035----	Settlement cluster	CNOC AN tSEANBHAILE	520960	734213
GA068-045----	Settlement cluster	AN BAILE NUA	518877	734857
GA068-046----	Enclosure	EOCHAIRE	518766	735407
GA068-047----	Settlement cluster	EOCHAIRE	518264	734987
GA068-051----	Ringfort - cashel	POLLAGH (Wormhole ED)	519429	738016
GA068-056----	Icehouse	ROSS DEMESNE	517669	737757
GA068-060----	Country house	ROSS DEMESNE	517761	737588
GA068-060001-	Well	ROSS DEMESNE	517823	737584
GA068-061001-	Church	ROSSCAHILL EAST	517087	738221
GA068-061002-	Graveyard	ROSSCAHILL EAST	517071	738226
GA068-061003-	Bullaun stone	ROSSCAHILL EAST	517028	738190
GA068-062----	Enclosure	ROSSCAHILL WEST	517200	739067
GA068-066----	Crannog	ROSS DEMESNE	517725	737471
GA068-069----	Designed landscape - tree-ring	ROSS DEMESNE	516996	737453
GA068-071----	Burial mound	AN POLLACH (TC Maigh Cuillinn)	519754	738045
GA068-072----	Cairn - unclassified	AN BAILE NUA	518356	733923
GA080-002----	Enclosure	LEITIR MEAS	513033	729236
GA081-036----	Megalithic structure	GORT UÍ LOCHLAINN	520376	732572
GA081-038----	Water mill-horizontal-wheeled	LIATHLEITIR	518011	732156
GA081-040----	Ringfort - rath	LIATHLEITIR	517978	730959

Table 11.1 Recorded monuments in *c.*5km radius from the proposed wind farm

Prehistoric period

The prehistoric period is represented by six cairns, one standing stone and a single megalithic structure.

Cairns are simply defined as a mound constructed primarily of stone used for a broad variety of purposes. In prehistoric times, they were raised as markers, as memorials and as burial monuments. In modern times, cairns

are often raised as landmarks, especially to mark the summits of mountains. There are six cairns in total within 5km study area including one ring-cairn within EIAR study area (GA067-029). The closest cairn located outside of the EIAR study area is unclassified cairn, GA067-031 situated in townland of Doon *c.*1.7km to the north of the nearest turbine.

Standing stones (gallán, dallán) are sometimes difficult to date; however, it is generally accepted that they belong to the Bronze Age and / or Iron Age. They appear to have served a variety of functions. Many were used as burial markers to designate the location of a cist grave, which was a simple slab-lined grave containing, cremated remains or single flexed articulated burials, usually accompanied by grave-goods. Certainly, standing stones appear to have been largely of ritual significance. Other standing stones are believed to have served as territorial markers to denote the extent of tribal or familial land boundaries. The only standing stone within 5km study area is GA067-028 located in townland of Uggool (Ogúil) *c.*3.8km to the west of the permitted turbines.

Megalithic structures are constructions of large stones of '*megalithic*' proportions which can't be classified as any other known archaeological monument type on present evidence. A single megalithic structure within the 5km study zone, GA081-036, is located in townland of Gortyloughlin (Gort Ui Lochlainn) *c.*4.3km to the southeast of the permitted turbines. This stone structure (L 3.6m), is roughly trapezoidal in plan, varies in width from 0.2m to 1m at its SSE end and it decreases in height from 1.0m to 0.6m (www.archaeology.ie).

Early Medieval Period (AD 400-1169)

The majority of the monuments within the 5km study area generally date to the early medieval period. These are: ringforts, enclosures, crannogs and bullaun stones.

Ringforts

Ringforts are subdivided into those of earthen construction known as a *rath* or *lios* or those of dry-stone construction that are referred to as a *caiseal*, *caher*, *cathair* and *dún.* Ringforts are also referred to as raths derived from the Old Irish word *ráth,* meaning '*earthen rampart*' while others are known as *lios* or *liss* which refers to the ringfort's interior space. The morphology of ringforts generally comprises of an earthen enclosing bank that was constructed by the casting up of material by the excavation of an outer circular or sub-circular ditch otherwise known as a fosse. In more prestigious examples there can be two (bi-vallate) or three (tri-vallate) enclosing banks and ditches. According to Stout (1997, 24), the majority of ringforts were constructed over a three-hundred-year period between the start of the 7th century and end of the 9th century AD. They represent enclosed farmsteads probably occupied by extended family units and are likely to have been largely self-sufficient. Domestic dwellings, outhouses, animal pens, food processing structures, craft areas, hearths and souterrains would have been located within the enclosing circular bank and ditch while other activity including corn drying kilns and iron working / smelting activity was often undertaken nearby outside for fire safety considerations. Farming included a mixed economy involving cereal growing and animal husbandry, in particular, dairying. Evidence of corn grinding, iron working, glass manufacture, spinning and weaving and food preparation has been recorded in association with domestic and animal timber dwellings and structures.

There are six ringforts located within wider 5km study zone. The closest one is located in townland of Doon *c.*3km to the north of the closest proposed turbine location. It's a poorly preserved subcircular cashel (GA067-009) (N-S 38.35m) defined by a much-collapsed drystone wall overlain at W by a modern field wall (www.archaeology.ie). With similar distance to the Proposed Development is another ringfort (GA081-040) located *c.*3.2km to the southeast from the nearest proposed turbine.

Enclosures

In addition, a total of thirteen enclosures are recorded within the 5km study zone. Some of these monuments are likely to represent denuded / levelled ringforts. Three enclosures are situated in similar distance to the proposed turbines. In the townland of Knockaunranny (*Cnocán Raithní*), *c.*2.3 km to the northeast of proposed turbines, a poorly preserved and very overgrown circular enclosure GA068-029 is located. A second enclosure (GA067-021) is situated in townland of Letter (*Leitir*) *c.*2.5km to the west and a third enclosure in the townland of Doon *c.*2.5km to the northeast of the proposed turbines.

Crannogs

Crannogs are ancient Irish lake dwellings built up by dumping timber, earth and stones onto a lake or riverbed, often revetted with timber piles or a palisade. Derived from the Irish word *'crannóg'*; the Irish word for tree is '*crann*' and '*crannóg*' principally means a piece of wood or a structure of wood. These monuments can date from the 6th to the 17th century AD. There are three crannogs located within the 5km study area. The closest to the Proposed Development is crannog GA068-066 located in the townland of Ross Demesne *c.*3.4km to the northeast of the permitted turbines.

Bullaun stones

The term 'bullaun' (from the Irish word '*bullán*', which means a round hollow in a stone, or a bowl) is applied to boulders of stone or bedrock with hemispherical hollows or basin-like depressions, which may have functioned as mortars. They are frequently associated with ecclesiastical sites and holy wells and so may have been used for religious purposes. Other examples which do not appear to have ecclesiastical associations can be found in bedrock or outcrop in upland contexts, often under blanket bog, and are known as bedrock mortars. They date from the prehistoric period to the early medieval period (5th-12th centuries AD) (www.archaeology.ie).

Three bullaun stones are located within wider 5km study area. The closest bullaun stone, GA068-009001- is situated in townland of Coolagh (*Cúil Each*) *c.*3.0km to the northeast of the permitted turbines.

Ecclesiastical enclosure

More or less coeval with the development of ringforts is the arrival of Christianity in Ireland. Monasticism was the principal characteristic of the Irish Christian Church whose origins lay in the Eastern Mediterranean inspired by Saints like Paul and Anthony who had retreated into the deserts of Egypt to live as hermit monks. Through time this monastic concept migrated into Ireland most likely through Gaul where its arrival had a profound impact on the existing spirituality of the Irish and witnessed the development of the 'Celtic Church'- a term that fell out of favour with more modern scholars but appears to be winning back somewhat today. Irish placenames with the word *dísert* (desert) is a memory of this.

The term *'ecclesiastical enclosure'* is defined as a large oval or roughly circular area, usually over 50m in diameter, defined by a bank/banks and external fosse/fosses or drystone wall/walls, enclosing an early medieval church or monastery and its associated areas of domestic and industrial activity. These date to the early medieval period (5th-12th centuries AD) (www.archaeology.ie).

A single ecclesiastical enclosure, GA068-012002 is located in the townland of Dovepark (*Páirc Na gColm*) *c.*3.4 km to the east of the permitted turbines.

Holy Wells

Some of the Early Christian ecclesiastical sites contain holy wells, many of whose origins can be pushed back to the prehistoric period associated with pre-Christian elder faiths (www.archaeology.ie). There are two holy wells within the 5km study area. The holy well recorded as *Tobar Ainthín* (GA068-025) is located *c.*4.3km northeast of the permitted turbines. It consisted of a natural spring delimited by a rectangular drystone wall (ibid). The second holy well, *Tobar Gráineog,* GA067-017001 is situated in Killaguile townland *c.*4.0km northwest of the permitted proposed wind farm. It also consisted of a natural spring enclosed by a circular drystone wall. According to local tradition it was used for the baptism of young children (ibid). Immediately to the east and associated to the well a penitential station (GA067-017002) is situated.

Horizontal water mill

A single example (GA081-038), of a horizontal mill is situated *c.*2.5km SE from the proposed wind farm between two lakes, Lough Atavamorn and Lough Atavabeg. These Early Medieval mills were driven by water directed on to a horizontal millwheel from a river, stream or spring, or head of water. These monuments are rare, only *c.*130 examples recorded in Ireland and only 13 in Galway (www.archaeology.ie). Horizontal water mills date primarily from the early 7th to the late 10th century AD.

High Medieval Period (AD 1169-1600)

The high medieval period began with the arrival of the Anglo-Normans in Ireland in AD 1169 when Diarmait MacMurchadha, deposed King of Leinster, sought the support of mercenaries to regain his kingdom. Two years later Richard de Clare (Strongbow) inherited the Kingdom of Leinster through marriage and by the end of the 12th century the Normans had succeeded in conquering much of the country (Stout and Stout 1997, 53).

Medieval period was the great time of Church development in Ireland. The Irish church changed fundamentally in the 12th Century, although many older church traditions survived. Architecturally, the advent of the arrival of the Normans and Cistercians and other major ecclesiastic church orders changed the form of Irish architecture from the existing rounded Romanesque arch to the pointed Gothic arch. This new Gothic form continued to dominate church architecture in this country until the Reformation. Furthermore, at a regional level, parish churches were built on the model of those in England.

Churches

Examination of the National Monument Service database recorded a total of five churches within the 5km study area. All these monuments are situated between 3.0 and 5.0 km from the turbines.

- Church GA068-012001 is located c.3.4km to the northeast of the permitted turbines. 'A very ruinous church (WNW-ESE; L > 11.46m, Wth >6.45m), probably medieval in date. No architectural features survive. Faint traces of a curving scarp to SE, S and W of church may indicate existence of an early ecclesiastical enclosure' (www.archaeology.ie).
- Church GA068-061001 is located c.3.8km to the northeast of permitted turbines. 'A much-ruined Early Christian oratory (E-W; L c. 4.6m, Wth 2.9m) with round-headed window in E gable. The W gable and parts of N and S walls are destroyed. A small graveyard lies immediately to W and a double bullaun c. 50m to SW'. (Ibid)
- Church GA068-024 (St Annin's Church) and associated graveyard (GA068-024001) is located c.4.3km to the northeast of permitted turbines. 'Poorly preserved medieval church (E-W; L 13.9m, Wth 6.9m) in a graveyard. There is a doorway in S wall close to SW corner and a plain window in E gable. Immediately to S is a mortuary chapel containing the tomb of a Major Poppelton, dated 1848'. (Ibid). There is also an early medieval cross-slab (GA068-024002) reused as an 18th century gravestone within the graveyard.
- Church GA068-005001 is located c.4.3 km to the northeast of permitted turbines. 'Correctly Teampall Beag na Naomh, this is a ruinous Early Christian oratory (E-W; L 5.9m, Wth 3.65m). Apart from a trabeate door, in W gable, it is otherwise featureless' (Ibid).
- Church GA068-015001 is located c.4.5km to the northeast of the permitted turbines. No information was found in NMS database. Examination of aerial imaginary revealed upstanding structure in this location.

Post-Medieval Period (AD 1600-1900)

In the mid-17th century Ireland was in ruins, over 20% of the population was dead after twelve terrible years of war starting in 1641 at the outbreak of the Catholic Confederation Wars and ultimately resulting in victory for the English armies under Oliver Cromwell in 1652. After the introduction of the Penal Laws (in effect from 1695-1829), there were extensive restrictions on Irish Catholics. There are several recorded monuments from this period within the 5km study area.

Children's Burial Grounds (CBG's)

These sites are often referred to as *killeens*, *cealluraghs* or *ceallúnaigh*. The practice of burying children and infants in separate set aside places appear to have occurred in Ireland since at least the late medieval period. It reflects the refusal by church authorities to allow the burial of unbaptised children on consecrated ground. Some studies have shown that the burial of infants was often carried out shortly after death, at night, usually by male members of the family. In many instances burials are marked by low uninscribed or unhewn upright slabs or unhewn white quartz stones. In addition to the possible CBG, GA067-033 situated within the EIAR study area and described above there are three other named CBG's situated within the 5km radius area.

- CBG, GA067-018 (*Cill na gCimógat*) at Killaguile townland is situated just *c.*140m to the southeast from the holy well (GA067-017001). It consisted of overgrown area limited by a low drystone wall. It is clearly depicted on 1st Ed. OS map.
- CBG, GA068-009 (*Lisín an Cealltrach*) at Coolagh townland consists of slightly raised rectangular area with number of small gravestone markers within the interior.
- CBG, GA068-034 (*Lisín na Leannaí)* at Knockshanbally townland clearly depicted at 1st Edition OS map.

Designed landscape feature

A designed landscape feature is a man-made feature that is laid out to produce the effect of natural scenery, or other features, usually within demesnes and associated with a country house estate. These date from the 17th to the 19th century AD. There are four recorded monuments of this type in the 5km study area all situated *c.*3km north of the permitted turbines: three in the townland of Doon quite close to each other (GA067-007; -008; -010) and one at Ross Demesne (GA068-069).

Other recorded monument types within the 5km study area from this period include:

- GA067-016001 classified as house - indeterminate date at Killaguile townland.
- A country house, GA068-060, (17th century – 1st half of 19th century) at Ross Demesne.
- An icehouse, GA068-056, (17th – 19th century) at Ross Demesne.
- GA067-023– comprises of a sheepfold (a pen or enclosure, usually constructed of drystone-walling, used for enclosing sheep) at Uggool townland. They date from the 18th century AD onwards.
- GA068-021 – a building (unknown function or date at Gortnamona East.
- GA068-031 – comprises of an unclassified castle on a small island in the Ross Lake with no visible surface trace survives.

Several other previously recorded monuments, now classified as redundant, will not be included in the next revision of the RMP. These include: -

- Three settlement clusters: GA068-035 at Knockshanbally, GA068-045 at Newtown and GA068-047 at Oghery all depicted on 1st Edition OS map.
- GA067-005 classified as a corn mill - these date from the 18th to the 20th century.
- GA068-013 previously classified as a country house at Páirc Na gColm
- GA067-036 – previously classified as a sheepfold comprise of two sheepfolds
- A lime kiln, GA067-027 is recorded in Buffy townland. These monuments can be dated from the medieval period onwards.

- GA067-034 and GA067-035 – the two most probably late 19th – early 20th century corn-drying kilns situated c.640m from each other at townland of Uggool and most probably associated with a production of poteen.
- GA068-028 – a quarry with no visible surface trace but marked on 1933 OS map at Knockaunranny townland.

11.3.2. Cultural heritage (CH) sites recorded during field inspection within the EIAR study area

A full and comprehensive inventory of cultural heritage sites within the EIAR and wider study area including field walking survey was undertaken during preparation of Chapter 14 of the previous EIS (Grogan 2013, Rubicon Heritage 2013). The previous field inspection revealed a series of previously unrecorded features within the EIAR study area boundary (Figure 11.3) as well as within the surrounding landscape.

Figure 11.3 Proposed development layout with cultural heritage sites within EIAR study area

Some of the cultural heritage sites recorded within the EIAR study area during the field walk include:

- **CH.24** Cairn/ring-cairn (GA067-029): Located outside of the proposed planning boundary. This circular cairn or ring-cairn (D11.5m) is located on the summit of Knockranny Hill and enjoys extensive views over the surrounding landscape. The cairn is situated on the level natural platform and has a circular shape in plan. The uneven interior (D c.7.35m) is lower and may have been robbed out. A small pyramidal pile of loose stone occupies the center of the feature and is a modern creation.
- **CH.29** Field wall and possible curvilinear feature: Located outside of proposed planning boundary. Located close to the summit of a low hill within a large peat cutting are the remains of an east-west field wall (c.16m long by 0.5 wide, up to 0.80m high. While the wall occurs within the cutting it is not clear that it extends under the eastern bank of the peat cutting. The wall consists of a number of small sized stones which are laid together while a constructing larger stone is located at the eastern end of the wall. Located c.5m to the south of the wall is a curvilinear C-shaped arrangement of stones is open to the north and measured approximately 4.75m wide.
- **CH.37** Small Mound. Located outside of proposed planning boundary. Located on the broad summit of a low hill, possible a clearance cairn (7-8m x 6m x c.0.30m high)
- **CH.41** Hut site with two annexes: Located outside of proposed planning boundary. Located on the crest of a prominent knoll in the landscape is a large sub-circular hut circle with two annexes. The central circle is the largest and measures 4m long by 4.5m wide. A low line of small to medium sized stone defines the edge of the circle. An open area to the northeast possibly forms the entrance to the central hut. The first annex adjoins the hut to the north-northwest and is also sub-circular in plan. It measures 2.5m long by 2m wide. The second annex is located adjoining the central hut circle to the east and has a sub-square shape in plan. This annex measure 2m long by 2m wide. The site enjoys extensive views over the surrounding landscape to the west of Knockranny Hill [redacted]
- **CH.53** S-Shaped enclosure: Located outside of proposed planning boundary. Located on the crest of a low hillock is a crude circle (12m internal diameter) formed by a single line of boulders (c.0.80m x 0.50m x 0.50m) but with a gap on the east to SSE side. A U-shape setting of similar boulders, open to the west side, is attached to the northeast side. In is situated on a low natural tongue of land extending northeast from the foot of Cnoc Raithni.
- **CH.60** Low field wall. Located outside of proposed planning boundary. This is a short section of casual walling apparently inserted to block erosion of screen of sheep run; there is no convincing evidence that this is pre-bog or ancient.
- **CH.64** Oval-shaped Mound: Located outside of proposed planning boundary. This is an entirely natural feature (32m by 18m and 2.2m high).
- **CH.69** Hut site (GA067-032): Located outside of proposed planning boundary. Oval structure (9.50m W/E x 5.30m) define externally by a low boulder wall with possible entrance at western part situated on a gentle NW slope in wet terrain.
- **CH.70** Possible mound: Located outside of proposed planning boundary. Low (c.0.50m high) amorphous bump (c.4.50m in diameter) situated beside the CH.69. Might be natural.
- **CH.71.01 & CH.71.02** Small isolated settlement and a field: Located outside of proposed planning boundary. A small rectangular house (c.6m x 4m) on the eastern side of triangular field.
- **CH.72** Children's burial ground (GA067-033). Located within the proposed planning boundary. Based on local information. No visible trace above the ground (Rubicon Heritage 2013).

A full list of cultural heritage sites within the EIAR and within wider study area was detailed in Appendix 14 of previous EIS (2013).

11.3.3. Aerial photography

A suite of aerial imagery was examined including ortho-imagery available from the OS (www.osi.ie) which includes B&W imagery from 1995 and colour imagery from 2000 and 2005. Higher resolution aerial imagery from the OS via the NMS portal (www.archaeology.ie) was also examined as well as sequential aerial imagery from Google Earth (taken between 2006 and 2022) and Bing Maps from 2018. Examination of the aerial imagery failed to reveal any previously unknown features of archaeological potential or cultural heritage within the EIAR study area or its immediate environs.

11.3.4. Excavations Ireland database

A review of the Excavations Bulletin (1970 – 2023) revealed that no previous licensed archaeological works took place within the EIAR study area or townlands of Knockranny, Letter or Ardderroo (www.excavations.ie). The closest archaeological licensed archaeological work was a monitoring associated with construction of the Galway Wind Park development undertaken *c.*2.5km to the west, within the townlands of Lettercraffroe, Uggool, Cloosh and Seecon. The results of the archaeological monitoring, which was carried out between December 2014 to June 2016 under License No.13E0169, were entirely negative.

11.3.5. Topographical files

Information on stray artefact finds from the receiving environment in County Galway has been recorded by the National Museum of Ireland since the late 18th century. There are no records of finds recorded within the EIAR study area or its three townlands (www.heritagemaps.ie).

11.3.6. Protected Structures and National Inventory of Architectural Heritage (NIAH)

There are no Protected Structures recorded or NIAH structures within the EIAR study area. The closest protected structure is Ross Railway Station (Reg. No. 30406804) located *c.*3.2km to the north of permitted turbines.

11.3.7. Cultural heritage sites on 1st Edition OS map

Cultural heritage assets can incorporate both archaeological and built heritage remains which are not subject to statutory protection, or which have not been previously recorded as heritage assets in any known datasets. To identify cultural heritage sites within the EIAR study area the historic Ordnance Survey mapping, aerial photographs and field inspections were assessed (see above).

A characteristic of the post-medieval landscape are the vernacular buildings that in the majority represent the domestic dwellings. '*Vernacular'* is a term used to describe traditional buildings constructed using locally available materials and according to local styles. Vernacular structures were usually built of local rubble stonework using lime mortar or more rarely of clay. Depending on the region and county, vernacular buildings were constructed with red brick, limestone or sandstone, or a combination of those together. Examples of other structures that may fall into this category include shops, outbuildings, mills, limekilns, farmsteads, forges, gates and gate piers.

Examination of the pre-famine 1st Edition OS 6" map of 1842 revealed several locations of vernacular structures within the EIAR study area (Figure 11.4). Two conjoined settlements – Cloghvally A and B are located in the vicinity of permitted Turbine 7 - where Cloghvally B (vernacular structure 1, Figure 11.4) is abutting the proposed planning boundary to the north. The second structure is situated in vicinity to the permitted Turbine 13, within the planning boundary. It comprises of a single building, possible small house or a shed - the remains of which can be seen at present. Comprehensive research of the 19th century landscape of Knockranny was undertaken by Dr. Eoin Grogan. Apart from these structures there are several stone boundary walls dating to the post-medieval period located within the proposed planning application red line boundary.

No additional cultural heritage sites were recorded on the 1st Edition map within the footprint of the proposed underground electrical and communications cabling connecting the 11 no. wind turbines to the Ardderroo substation and wider study area. The land on the OSi map is depicted mostly as a featureless bog. However, the proposed grid connection will cross two townland boundaries depicted on the 1st Ed. OSi map: at Letter - Ardderroo and Ardderroo – Knockranny. These boundaries also form part of the parish boundary between Killanin and Moycullen.

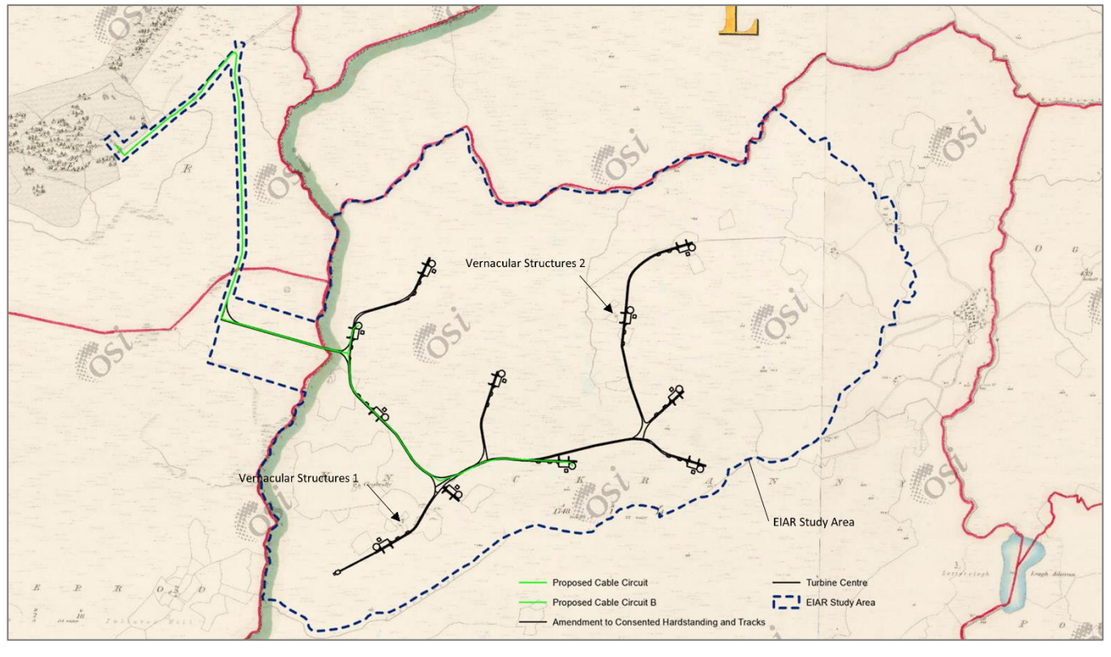

Figure 11.4 Extract from the 1st Edition OS map with the Proposed Development overlain.

11.3.8. Cartographic research

11.3.8.1. Down Survey

In the mid-17th century Ireland was in ruins, over 20% of the population was dead after twelve terrible years of war starting in 1641 at the outbreak of the Catholic Confederation Wars and ultimately resulting in victory for the English armies under Oliver Cromwell in 1652. Cromwell immediately set about an immense project of social engineering underpinned by a massive transfer of landownership from the native Catholics to English Protestants. For this to happen the land had to be accurately mapped and surveyed and this enormous undertaking was given to Wm Petty who was surgeon-general in the English army. This was the largest land survey of its kind anywhere in the world at the time and was undertaken between 1656-1658 and was known as the Down Survey. The survey to measure all the forfeited land was necessary in order to facilitate its re-distribution to the ownership of the English Protestant grantees comprising merchant adventurers and also as payment to English soldiers (www.downsurvey.tcd.ie). For this to happen an act known as the Act of Settlement of Ireland was passed on the 12th August 1652 that divided the defeated Catholic Royalists into eight different classes. The leaders of the first six classes not only forfeited their lands but were also sentenced to death. The seventh class represented swordsmen under the rank of gentlemen who forfeited two-thirds of their land while the eighth class were those who remained neutral and if Catholic lost one third and if Protestant lost one twentieth. The forfeiting landowners were commanded to appear at Loughrea immediately after Christmas 1653 and to bring with them their Certificates of Transplantation issued by the Cromwellians.

The Down Survey was examined for the three townlands of the EIAR study area (Table 11-2). Only the county map is available as the barony maps for Galway are recorded as being destroyed in 1711.

Two of the townlands, Knockranny (Cullragh) and Ardderroo (Ardnassellagh), belonged to Protestant landowners while Letter townland (Leater and Mallan) was owned by a Catholic. Ardderroo (Ardnassellagh) in 1641 as well as in 1670 was in the possession of the Earl of Clanrickard who also owned vast lands in Co. Galway (578 townlands in total). There is no information about the specific ownership of Knockranny (Cullragh) in 1641 but in 1670 it was owned by a Protestant John Eyres together with 56 other townlands in Co. Galway. Letter townland (Leater and Mallan) was retained in Catholic possession throughout these turbulent times: in 1641 by Ervan Flaharty and in 1670 by Stephen Lynch (www.downsurvey.tcd.ie). It is surmised that the land quality of the townland was particularly poor.

Townland	Down Survey Name	1641 Owner(s):	1670 Owner(s):	Parish	Profitable land	Unprofitable land	Forfeited
Ardderroo	Ardnassellagh	Earl of Clanrickard, (Protestant)		Killanine and Killcomyn	128 plantation acres	38 plantation acres	128 plantation acres
Knockranny	Cullragh	No info	John Eyres (Protestant)	Muckullin	51 plantation acres	459 plantation acres	51 plantation acres
Letter	Leater and Mallan	Ervan Flaharty (Catholic)	Stephen Lynch (Catholic)	Killannin	177 plantation acres	486 plantation acres	177 plantation acres

Table 11.2 Townlands within the EIAR in Down Survey (www.downsurvey.tcd.ie)

11.3.9. Placename

Townlands comprise the smallest unit of land division in the Irish landscape, and many may preserve early Gaelic territorial boundaries that pre-date the Anglo-Norman conquest. The layout and nomenclature of the Irish townlands were recorded and standardized by the work of the Ordnance Survey in the 19th century. The Irish roots of townland names often refer to natural topographical features, but some name elements may also give an indication of the presence of past human activity within the townland. For instance, placename elements such as *lis, dun* and *rath* indicate the presence of a ringfort; while *kill* and temple suggest an association with a church site. (www.logainm.ie). The three townland names in the study area are toponyms (Table 11.3).

Townland	Irish Name	Translation
Ardderroo	*Ard-doiriú*	Ard: *'height; high', doiriú-oak-wood*
Knockranny	*Cnoc Raithní*	Cnock: hill: great, big *'Great Glen'*
Letter	*Leitir*	Leitir: 'Hillside'

Table 11.3 Townlands names and meaning within the EIAR (www.logainm.ie).

11.4. Likely Significant Impacts

11.4.1. Do Nothing Scenario

In the do-nothing scenario, the Permitted Development would be constructed with no additional significant impacts arising on that previously assessed.

11.4.2. Assessment of Effects During Construction (Indirect effects)

Indirect effects, in terms of archaeology, architectural and cultural heritage includes impacts on visual setting of any cultural heritage asset in the wider landscape. Since these visual effects are only possible once turbines are constructed, they are considered operational effects and are therefore discussed in Section 11.4.4 below. No indirect effects were identified which would occur at the construction stage.

11.4.3. Assessment of Effects During Construction (Direct effects)

Direct effect refers to a physical impact on monuments, features or sites during the construction phase. The potential physical impacts to known and unknown archaeological features are outlined below.

When compared with the Permitted Development, the Proposed Development will provide for an increase in turbine blade tip height, rotor blade length and hub height, larger turbine foundations (albeit within the footprint of permitted hardstand areas), omission of a 110kV substation, access road widening, additional access tracks and new underground electrical and communications cabling from the 11 no. turbines to the existing Ardderroo substation.

11.4.3.1. National monuments

No National Monuments in State Ownership/Guardianship are located within or adjacent to the EIAR study area and therefore there will be no direct impacts on any by construction of the Proposed Development. The nearest National Monument is Aughnanure, Castle (NMN 470) is located *c.*7km to the North of the Proposed Development.

11.4.3.2. Recorded monuments within EIAR study area

There are four recorded monuments within the EIAR study area:

- Children's burial ground GA067-033: The Proposed Development includes a minor alteration to the foundation size, but this will be contained within the footprint of the hardstand area for the Permitted Development. The precise location is currently unknown. There may be a physical impact to the monument during the construction phase as it is located within the planning application boundary immediately east of Turbine 6 hardstand. Considering that the turbine location is outside the indicative area of the possible burial ground and its Zone of Notification (ZON), the likely physical impact is classified as 'slight 'to 'moderate'.

- Hut site GA067-032: There will be no physical impact to the recorded monument as it is located outside of the planning boundary, *c.*340m from the nearest turbine.
- Cairn GA067-029: This relates to two of the four identified monuments. There will be no physical impact to the cairn and cist (GA067-029 and -029001) as monuments are located outside of the planning boundary, *c.*270m from the nearest turbine.

There are no recorded monuments within the proposed underground electrical and communications cabling connecting the 11 no. wind turbines to the Ardderroo substation. Consequently, there will be no impact on any recorded monument by its construction.

11.4.3.3. Previously unrecorded archaeological features or sites

There may be a physical impact to previously unknown archaeological features or sites within the EIAR study boundary. Considering the small number of recorded monuments within the EIAR study area and poor-quality of the land, (comprising of lowland blanket peat bog, semi-improved pastures and forestry), the impact is classified as '***slight***''.

11.4.3.4. National Inventory of Architectural Heritage (NIAH) structures and Protected Structures

No Protected Structures or structures/items listed in the NIAH are located within the EIAR study area. The closest located Protected Structure is Ross Railway Station (RPS 700) located *c.*3.2km to the North of proposed turbines. There will be no direct impact on any NIAH structure or protected structure.

11.4.3.5. Cultural heritage sites

- There may be a physical impact to Cloghvally 'B' vernacular settlement as the proposed planning boundary abuts the southernmost fields of this rural settlement. There may be a physical impact to the site of the single house depicted on the 1st Edition OS map located within the planning boundary in vicinity of T13. The Proposed Development provides for a minor change in foundation size within the Permitted Development hardstand area. The impact on these features is classified from '***not significant'*** to '***slight***'' as both structures are not situated on the direct footprint of turbines or internal access/grid connection route.
- Under the Permitted Development, there is no change to the construction of the access road / grid connection to Turbine 11 on the easternmost limits of vernacular settlement 2. The impact is classified as '***not significant'***.
- There will be a direct physical impact on two townland boundaries on the route of the proposed underground electrical and communications cabling connecting the 11 no. wind turbines to the Ardderroo substation. The impact on Letter – Ardderroo townland boundary is classified as '***not significant'*** as there is the existing road at the location. The impact on Ardderroo – Knockranny townland boundary formed and demarcated by a stream, is classified as '***moderate***'.
- There will be no physical impact to any other cultural heritage sites within the EIAR study area arising from construction of the Proposed Development.

11.4.4. Assessment of Effects During Operation (Indirect effect)

Indirect impact describes the presence of the development during the operation phase when it may cause change to the surroundings of the archaeological or architecture heritage. The underground electrical and communications cabling and extension to the Ardderroo substation will not impact on the visual setting of any features of heritage value. The increase in blade tip height, rotor blade length and hub height of the Proposed Development relative to the Permitted Development is the primary consideration.

11.4.4.1. National Monuments in State Care

There will be a visual impact to the nearest National Monument - Aughnanure Castle (NMN 470) located *c.*7km to the north of the Proposed Development turbines. The interior of the castle is open for the public and in that context the turbines may be visible from the higher levels of the monument. Considering the intervening distance, minor visual change of the Proposed Development turbines from same, and the fact that the castle is surrounded by mature trees, the impact is classified as '***not significant'***.

11.4.4.2. Recorded monuments within EIAR study area

- Children's burial ground GA067-033: There will be no visual impact to the monument as it is not visible at ground level and its precise location is not known.
- Hut site GA067-032: Considering low level class of the monument, and the minor increase in scale of turbines under the Proposed Development, the visual impact is classified as '***not significant'***.
- Cairn GA067-029: The cairn is situated *c.*270m to the east of permitted Turbine 2. At this distance, and in consideration of the increase in scale of the Proposed Development turbines, the cultural visual impact is classified as '***slight '.***

11.4.4.3. Recorded monuments within 5km study area

There are a total of 85 recorded monuments within the 5km radius study area including 10 redundant records. The vast majority of these nearest the Proposed Development consist of monuments with a low physical relict manifestation These monuments primarily include enclosures and ringforts or other monuments that have little surviving or no trace above ground such as children's burial grounds or settlement clusters. More prominent vertical visual upstanding monuments such as churches are located at a farther remove (over 3.0km from the permitted turbines). In that context, and in consideration of the design changes under the Proposed Development, all recorded monuments within the wider 5km study zone are classified as 'not significant' to 'slight '.

11.4.4.4. Cultural heritage sites

The visual impact on identified vernacular settlements arising from the Proposed Development on recorded rural settlements is classified as '***slight'*** to '***moderate***'. The operational impact on townland boundaries is classified as '***not significant'***.

11.4.4.5. National Inventory of Architectural Heritage (NIAH) and Protected Structures

There will be no visual impact on any identified protected structures or NIAH structures having regard to the proposed increase in scale of the 11 no. turbines. The closest protected structure is Ross Railway Station (RPS 700) located *c.*3.2km to the north of Proposed Development turbines. The nearest recorded NIAH structures are situated at a similar distance away.

11.5. Mitigation Measures and Monitoring

11.5.1. Construction Phase

There are no significant impacts requiring mitigation resulting from the Proposed Development however the following measures which were outlined in the original Permitted Development EIS are provided here again as best practice measures.

- The removal of stone field walls necessitated by the construction of access roads to Turbines 7 and 11 should be excavated, prior to the construction phase, by a suitably qualified and experienced archaeologist.
- In the context of the access road to Turbine 11 the removal of topsoil should be carried out under archaeological supervision as these fields were used for spade cultivation and there is potential for artefactual material associated with manuring.
- Ground works and topsoil removal at Turbine 6 should, in view of the possible location of a Children's burial ground (GA067-033) in the vicinity, be carried out under close archaeological supervision.
- During the construction phase all works involving topsoil removal, specifically the turbine foundation platforms and, the access roads and undisturbed ground of proposed grid connection, should be monitored by a suitably qualified and experienced archaeologist under license issue by the National Monuments Service (NMS) with in-built provision for rapid detailed excavation or any archaeological evidence uncovered during this process.
- Relative to the underground grid connection cable route, it is recommended that an archaeologist be present on site during the construction stage of the trench excavation for the cable route.

A report on the results of any licensed monitoring should be submitted to the National Monuments Service and Galway County Council on completion.

11.5.2. Operational Phase

The Proposed Development does not give rise to any specific mitigation requirements.

Consistent with the Permitted Development, it is advisable that consideration should be given to protecting the architectural and cultural heritage components from encroaching vegetation as part of routine landscape management. Targeted fenced grazing may be considered appropriate in the environs of settlement archaeology.

11.5.3. Decommissioning

No new archaeological or cultural heritage impacts will arise during the decommissioning phase of the project.

11.6. Residual Effects

With the identified mitigation in place for the Project, the Proposed Development will not have residual negative significant impacts on the archaeology or cultural heritage of the study area.

11.6.1. Construction Phase

Any potential direct impacts have been mitigated against through the implementation of appropriate mitigation measures during the pre-construction and construction phase of the Proposed Development. The residual impacts are classified as 'slight' and 'not significant'.

11.6.2. Operational Phase

There will be no significant residual impacts during the operational phase.

11.7. Cumulative Effects

Cumulative impacts are the potential combined impacts from other developments in conjunction with the Proposed Development. There are nine wind farms within c.10 km distance from the Proposed Development. The nearest of these, Ardderroo Wind Farm is currently under construction to the west. In addition, there are transport, domestic and agricultural projects in the area, in addition to forestry, peat and other activities. All identified developments within Section 1.10 of Chapter 1 have been considered.

11.7.1. Construction Phase

None. The Proposed Development will be constructed as part of Cnoc Raithni (Knockranny) Wind Farm Project, with the effects of Permitted Development previously assessed to not give rise to adverse impacts. The works arising from the Proposed Development do not give rise to any significant increase in effects on that permitted and potential cumulative effects with other projects at construction stage are not considered to be significant.

11.7.2. Operational Phase

None. The underground electrical and communications cabling will not result in any visual effects. Its length coupled with no known archaeology along its route means there is no compound effect on known archaeology in the area.

Chapter 4 of the EIAR has determined that the consequent increase in scale of the turbines under the Proposed Development will not contribute to any cumulative impacts. No significant cumulative setting effects from the Proposed Development and other projects is likely. All cumulative effects are considered to be not significant.

11.7.3. Decommissioning Phase

During the decommissioning phase, there will be minimal disturbance of soil/subsoil. The underground electrical cabling ducting will be left in-situ and turbine bases will not be removed but covered over with soil/subsoil. These works will be limited in scale and similar to that of the Permitted Development and there is no potential for cumulative effects with other nearby developments.

11.8. Difficulties Encountered in Compiling Information

No limitations/difficulties were encountered during this assessment.

11.9. References

- Galway County Development Plan (2022-2028)
- Grogan, E. (2013) The nineteenth century landscape of Knockranny. Appendix 14.2 (in) *Cnoc Raithithní (Knockranny) Wind Farm Proposal EIS* (Revise).
- Rubicon Heritage (2013) Chapter 14. Archaeology & Cultural Heritage (in) *Cnoc Raithithní (Knockranny) Wind Farm Proposal EIS* (Revise)
- Stout, G. and Stout, M., (1997) *Early Landscapes: from Prehistory to Plantation*. In: F.H.A. Aalen, F.H.A., Whelan, K. and Stout, M., (eds.) Atlas of the Irish Rural Landscape. Cork: Cork University Press
- www.archaeology.ie – National Monuments Service online sites and monuments records database
- www.downsurvey.tcd.ie - Down Survey Map c.1655
- www.excavations.ie – Summary of archaeological excavation from 1970–2023
- www.heritagemaps.ie – The Heritage Council web-based spatial data viewer which focuses on the built, cultural and natural heritage.
- www.logainm.ie –Placenames Database of Ireland launched by *Fiontar agus Scoil na Gaelige* and the DoCHG.
- www.osiemaps.ie – Ordnance Survey of Ireland Ortho-imagery from 2005, 2000 & 1995

CNOC RAITHNÍ (KNOCKRANNY) WIND FARM

CHAPTER 12

Noise and Vibration

VOLUME II EIAR

CHAPTER 12 – Noise and Vibration

Contents

Chapter12

12. NOISE AND VIBRATION

12.1. Introduction

This chapter of the EIAR describes the assessment undertaken of the potential noise and vibration impacts associated with the Proposed Development. This application seeks to amend the Permitted Development comprising alterations to the dimensions of the 11 no. wind turbines permitted as part of the Cnoc Raithni (Knockranny) Wind Farm, omission of the permitted onsite substation, whilst seeking permission for proposed underground electrical and communications cabling connecting the 11 no. wind turbines to the Ardderroo substation, as well as extension to substation control building and new step up transformer. A full description of the Proposed Development is provided in Chapter 2 of this EIAR. There are 270 no. noise sensitive locations (NSLs) within 3.3 km of the proposed turbine locations.

An environmental noise survey to quantify the existing baseline noise environment at NSLs was previously conducted by Malachy Walsh and Partners as part of the planning assessment for the Permitted Development. The details of the environmental baseline noise survey are presented Section 12.4.

Existing, permitted and proposed wind farm developments have been identified in the wider EIAR Study Area and the cumulative impact of these developments has been considered in this assessment in line with guidance set out in the Institute of Acoustics (IOA) document A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (2013) (IOA GPG). Further details on each of these developments is provided in Chapter 2 of this EIAR.

12.1.1 Fundamentals of Acoustics

A sound wave travelling through the air is a regular disturbance of the atmospheric pressure. These pressure fluctuations are detected by the human ear, producing the sensation of hearing. To take account of the vast range of pressure levels that can be detected by the ear, it is convenient to measure sound in terms of a logarithmic ratio of sound pressures. These values are expressed as Sound Pressure Levels (SPL) in decibels (dB).

The audible range of sounds expressed in terms of Sound Pressure Levels (SPL) is 0dB (for the threshold of hearing) to 120dB (for the threshold of pain). In general, a subjective impression of doubling of loudness corresponds to a tenfold increase in sound energy which conveniently equates to a 10dB increase in SPL. It should be noted that a doubling in sound energy (such as may be caused by a doubling of traffic flows) increases the SPL by 3 dB.

The frequency of sound is the rate at which a sound wave oscillates is expressed in Hertz (Hz). The sensitivity of the human ear to different frequencies in the audible range is not uniform. For example, hearing sensitivity decreases markedly as frequency falls below 250Hz. In order to rank the SPL of various noise sources, the measured level has to be adjusted to give comparatively more weight to the frequencies that are readily detected by the human ear. The 'A-weighting' system defined in the international standard, BS ISO 226:2003 Acoustics. Normal Equal-loudness Level Contours has been found to provide the best correlations with human response to perceived loudness. SPL's measured using 'A-weighting' are expressed in terms of dB(A).

An indication of the level of some common sounds on the dB(A) scale is presented in Figure 12.1. Appendix 12-1 contains a glossary of acoustic terminology used throughout this chapter.

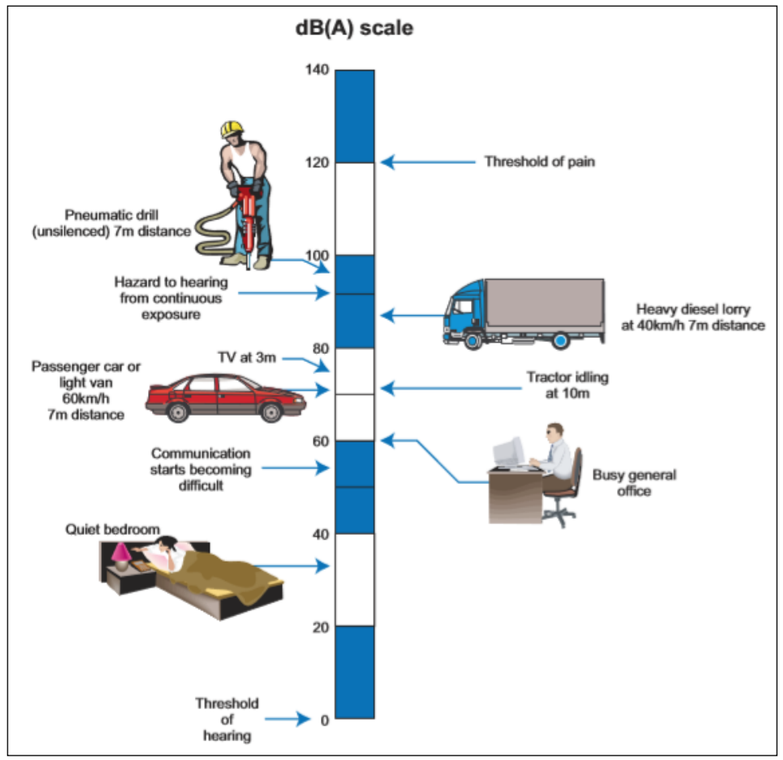

Figure 12.1 the level of typical common sounds on the dba scale good practice guidance for the treatment of noise during the planning of national road schemes)

12.2. Assessment Methodology

The assessment of impacts has been undertaken with reference to the most appropriate guidance documents relating to noise and vibration for both the operational and construction phases of the Proposed Development, which are set out within the relevant sections of this chapter.

In addition to the specific guidance documents outlined below, the Environmental Impact Assessment (EIA) guidelines listed in Section 1.4.1 of Chapter 1 were considered and consulted for the purposes of preparing this EIAR chapter.

The methodology adopted for this noise impact assessment is summarised as follows:

- Review of appropriate guidance to identify appropriate noise and vibration criteria for both the construction and operational phases;

- Characterise the receiving environment through baseline noise surveys at various NSLs surrounding the proposed development;
- Undertake predictive calculations to assess the potential impacts associated with the construction phase of the proposed development at NSLs;
- Undertake predictive calculations to assess the potential impacts associated with the operational phase of the Proposed Development at NSLs; evaluate the potential noise and vibration impacts and effects;
- Specify mitigation measures to reduce, where necessary, the identified potential outward impacts relating to noise and vibration from the Proposed Development, and;
- Describe the significance of the residual noise and vibration effects associated with the Proposed Development.

12.2.1 Guidance Documents and Assessment Criteria

The following sections review best practice guidance that is commonly adopted in relation to developments such as the one under consideration here.

12.2.1.1. Construction Phase

Construction Noise

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Local authorities normally control construction activities by imposing limits on the hours of construction works and may consider noise limits at their discretion.

In the absence of specific noise limits, appropriate criteria relating to permissible construction noise levels for a development of this scale may be found in the *British Standard 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise*.

The approach adopted here calls for the designation of a NSL into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. This then sets a threshold noise value that, if exceeded (construction noise only) at the façade of residential, noise sensitive locations, indicates a potential significant noise impact is associated with the construction activities.

Table 12.1 sets out the values which, when exceeded, potentially signify a significant effect at the facades of residential receptors as recommended by BS 5228-1. These levels relate to construction noise only.

Table 12.1 Example Threshold of Potential Significant Effect at Noise Sensitive Locations

Assessment category and threshold value period (T)	Threshold values, LAeq,T dB		
	Category A Note A	Category B Note B	Category C Note C
Night-time (23:00 to 07:00hrs)	45	50	55
Evenings and weekends Note D	55	60	65
Daytime (07:00 – 19:00hrs) and Saturdays (07:00 – 13:00hrs)	65	70	75

Note A Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.
Note B Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.
Note C Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.
Note D 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

The following assessment method is only valid for residential properties.

For the appropriate period (e.g. daytime) the ambient noise level is determined and rounded to the nearest 5 dB. In this instance, with the rural nature of the site, properties near the development have daytime ambient noise levels that typically range from 40 to 50 dB $L_{Aeq,1hr}$. Therefore, as a precautionary approach, all properties will be afforded a Category A designation.

See Section 12.4.2 for the detailed assessment in relation to this site. If the specific construction noise level exceeds the appropriate category value (e.g. 65 dB $L_{Aeq,12hr}$ during weekday daytime periods) then a significant effect is deemed to have occurred.

Additional Vehicular Activity on Public Roads

There are no specific guidelines or limits relating to traffic related sources along the local or surrounding roads. Given that traffic from the construction of the Proposed Development will make use of existing roads already carrying traffic volumes, it is appropriate to assess the calculated increase in traffic noise levels that will arise because of vehicular movements associated with construction works.

In order to assist with the assessment of construction traffic noise, reference is made to the Design Manual for Roads and Bridges LA 111 (DMRB), Highways England Company Limited, Transport Scotland, The Welsh Government and The Department for Regional Development (Northern Ireland), (hereafter referred to as DMRB) The DMRB has been used to assess the likely magnitude of effect associated with changes in traffic noise levels along an existing road. Table 12.2 below presents the likely effects associated with change in traffic noise level and is adapted from Table 3.17 of the DMRB to include a column on the significance of effects in EPA/EIAR terms.

Table 12.2 Likely Impacts Associated with Change in Traffic Noise Level (Source DMRB, 2020)

Change in Sound Level	Subjective Reaction	Magnitude of Impact	EPA Significance of Effect
Less than 1 dB	Inaudible	Negligible	Imperceptible
1.0 – 2.9	Barely Perceptible	Minor	Not significant
3.0 – 4.9	Perceptible	Moderate	Slight, Moderate
5+	Up to a doubling of loudness	Major	Significant

In accordance with the DMRB, construction noise and construction traffic noise effects shall constitute a significant effect where it is determined that a major or moderate magnitude of effect will occur for a duration exceeding:

- Ten or more days or nights in any 15 consecutive day or nights, or
- A total number of days exceeding 40 in any six consecutive months.

The guidance outlined in Table 12.2 will be used to assess the predicted increases in traffic levels on public roads associated with the construction of the Proposed Development. Where an impact is identified due to the change in traffic noise level, reference will be made to the overall predicted noise level from construction traffic in the context of the construction noise criteria outlined in Section 12.4.1.1.

Construction Vibration

Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. With respect to this development, the range of relevant criteria used for building protection is expressed in terms of Peak Particle Velocity (PPV) in mm/s.

Guidance relevant to acceptable vibration within buildings is contained in the following documents:

- BS 7385 – Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration (1993); and
- BS 5228 – Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration (2009+A1:2014).

BS 7385 states that there should typically be no cosmetic damage if transient vibration does not exceed 15 mm/s at low frequencies rising to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above.

BS 5228 recommends that, for soundly constructed residential property and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak particle velocity of 15 mm/s for transient vibration at frequencies below 15 Hz and 20 mm/s at frequencies above than 15 Hz. Below these vibration magnitudes minor damage is unlikely, although where there is existing damage these limits may be reduced by up to 50%. In addition, where continuous vibration is generated the limits discussed above may need to be reduced by 50%.

The Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA)) document Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes (TII, 2014) also contains information on the permissible construction vibration levels during the construction phase as shown in Table 12.3.

Table 12.3 Transient Vibration Guide Values for Cosmetic Building Damage

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of		
Less than 10Hz	10 to 50Hz	50 to 100Hz (and above)
8 mm/s	12.5 mm/s	20 mm/s

12.2.1.2. Operational Phase

Noise

The noise assessment summarised in the following sections has been based on guidance in relation to acceptable levels of noise from wind farms as contained in the document "Wind Energy Development Guidelines" published by the Department of the Environment, Heritage and Local Government in 2006 (hereafter referred to as WEDG). These guidelines are in turn based on detailed recommendations set out in the Department of Trade & Industry (UK) Energy Technology Support Unit (ETSU) publication "The Assessment and Rating of Noise from Wind Farms" (1996). The ETSU document has been used to supplement the guidance contained within the WEDG publication where necessary.

Commentary on the current planning condition applicable to the Permitted Development is provided in Section 12.4.3.

Wind Energy Development Guidelines

Section 5.6 of the WEDG addresses noise and outlines the appropriate noise criteria in relation to wind farm developments.

The following extracts from this document should be considered:

> *"An appropriate balance must be achieved between power generation and noise impact."*

While this comment is noted it should be stated that the Guidelines give no specific advice in relation to what constitutes an 'appropriate balance'. In the absence of this, guidance will be taken from alternative and appropriate publications.

> *"In the case of wind energy development, a noise sensitive location includes any occupied house, hostel, health building or place of worship and may include areas of particular scenic quality or special recreational importance. Noise limits should apply only to those areas frequently used for relaxation of activities for which a quiet environment is highly desirable. Noise limits should be applied to external locations and should reflect the variation in both turbine source noise and background noise with wind speed."*

As can be seen from the calculations presented later in this chapter the various issues identified in this extract have been incorporated into our assessment.

> *"In general, a lower fixed limit of 45dB(A) or a maximum increase of 5dB(A) above background noise at nearby noise sensitive locations is considered appropriate to provide protection to wind energy development neighbours."*

This represents the commonly adopted daytime noise criterion curve in relation to wind farm developments. However, an important caveat should be noted as detailed in the following extract.

> *"However, in very quiet areas, the use of a margin of 5dB(A) above background noise at nearby noise sensitive properties is not necessary to offer a reasonable degree of protection and may unduly restrict wind energy developments which should be recognised as having wider national and global benefits. Instead, in low noise environments where background noise is less than 30dB(A), it is recommended that the daytime level of the LA90, 10min of the wind energy development be limited to an absolute level within the range of 35 – 40dB(A)."*

In relation to night-time periods the following guidance is given:

> *"A fixed limit of 43dB(A) will protect sleep inside properties during the night."*

This limit is defined in terms of the $L_{A90,10min}$ parameter. This represents the commonly adopted night-time lower limit noise criterion curve in relation to wind farm developments.

In summary, the Wind Energy Development Guidelines outlines the following guidance to identify appropriate wind turbine noise criteria curves at noise sensitive locations:

- An appropriate absolute limit level for quiet daytime environments with background noise levels of less than 30 dB $L_{A90,10min}$;
- 45 dB $L_{A90,10min}$ for daytime environments with background noise levels of greater than 30 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher), and;
- 43 dB $L_{A90,10min}$ for night time periods.

While the caveat of an increase of 5dB(A) above background for night-time operation is not explicit within the current guidance it is commonly applied in noise assessments prepared and is detailed in numerous examples of planning conditions issued by local authorities and An Bord Pleanála, including the current planning permission for the Permitted Development. Therefore, a night-time allowance for 5dB(A) above background has also been adopted for this assessment.

This set of criteria has been chosen as it is in line with the intent of the relevant Irish guidance. The proposed operational noise criteria curves for wind turbine noise at various noise sensitive locations are presented in Section 12.4.2.

The Assessment and Rating of Noise from Wind Farms – ETSU-R-97

As stated previously the core of the noise guidance contained within the Wind Energy Development Guidelines is based on the 1996 ETSU publication The Assessment and Rating of Noise from Wind Farms (ETSU-R-97).

ETSU-R-97 calls for the control of wind turbine noise by the application of noise limits at the nearest noise sensitive properties. ETSU-R-97 considers that absolute noise limits applied at all wind speeds are not suited to wind turbine developments and recommends that noise limits should be set relative to the existing background noise levels at noise sensitive locations. A critical aspect of the noise assessment of wind energy proposals relates to the identification of baseline noise levels through on-site noise surveys.

ETSU-R-97 states on page 58, "…absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area which contribute to the noise received at the properties in question…". Therefore, the noise contribution from all wind turbine developments in the area should be included in the assessment.

Institute of Acoustics Good Practice Guide

The guidance contained within the institute of Acoustics (IOA) document A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (2013) (IOA GPG) and Supplementary Guidance Notes are considered to represent best practice and have been adopted for this assessment. The IOA GPG states, that at a minimum continuous baseline noise monitoring should be carried out at the nearest noise sensitive locations for typically a two-week period and should capture a representative sample of wind speeds in the area (i.e. cut in speeds to wind speed of rated sound power of the proposed turbine). Background noise measurements (i.e. LA90,10min) should be related to wind speed measurements that are collated at the site of the wind turbine development. Regression analysis is then conducted on the data sets to derive background noise levels at various wind speeds to establish the appropriate day and night-time noise criterion curves.

Noise emissions associated with the wind turbine can be predicted in accordance with ISO 9613: Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation (1996). This is a noise prediction standard that considers noise attenuation offered, amongst others, by distance, ground absorption, directivity and atmospheric absorption. Noise predictions and contours are typically prepared for various wind speeds and the predicted levels are compared against the relevant noise criterion curve to demonstrate compliance with the appropriate noise criteria.

Where noise predictions indicate that reductions in noise emissions are required in order to satisfy any adopted criteria, consideration can be given to detailed downwind analysis and operating turbines in low noise mode, which is typically offered by modern wind turbine units.

Reference has been made to the IOA GPG for guidance on the methodology for the background noise survey and operation impact assessment for wind turbine noise.

World Health Organisation (WHO) Noise Guidelines for the European Region)

The WHO Environmental Noise Guidelines for the European Region (2018) provide guidance on protecting human health from exposure to environmental noise. They set health-based recommendations based on average environmental noise exposure of several sources of environmental noise, including wind turbine noise. Recommendations are rated as either 'strong' or 'conditional'. A strong recommendation, "can be adopted as policy in most situations" whereas a conditional recommendation, "requires a policy-making process with substantial debate and involvement of various stakeholders. There is less certainty of its efficacy owing to lower quality of evidence of a net benefit, opposing values and preferences of individuals and populations affected or the high resource implications of the recommendation, meaning there may be circumstances or settings in which it will not apply".

The objective of the World Health Organisation (WHO) Environmental Noise Guidelines for the European Region that was published in October 2018 is to provide recommendations for protecting human health from exposure to environmental noise from transportation, wind farm and leisure sources of noise. The guidelines present recommendations for each noise source type in terms of Lden and Lnight levels above which there is potential for adverse health risks.

In relation to wind turbine noise, the WHO Guideline Development Group (GDG) state the following:

> *"For average noise exposure, the GDG conditionally recommends reducing noise levels produced by wind turbines below 45 dB Lden, as wind turbine noise above this level is associated with adverse health effects.*
>
> *No recommendation is made for average night noise exposure Lnight of wind turbines. The quality of evidence of night-time exposure to wind turbine noise is too low to allow a recommendation.*
>
> *To reduce health effects, the GDG conditionally recommends that policymakers implement suitable measures to reduce noise exposure from wind turbines in the population exposed to levels above the guideline values for average noise exposure. No evidence is available, however, to facilitate the recommendation of one particular type of intervention over another."*

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

The WHO Environmental Noise Guidelines aim to support the legislation and policy-making process on local, national and international level, thus shall be considered by Irish policy makers for any future revisions of Irish National Wind Energy Guidelines.

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

> *"Even though correlations between noise indicators tend to be high (especially between LAeq like indicators) and conversions between indicators do not normally influence the correlations between the noise indicator and a particular health effect, important assumptions remain when exposure to wind turbine noise in Lden is converted from original sound pressure level values. The conversion requires, as variable, the statistical distribution of annual wind speed at a particular height, which depends on the type of wind turbine and meteorological conditions at a particular geographical location. Such input variables may not be directly applicable for use in other sites. They are sometimes used without specific validation for a particular area, however, because of practical limitations or lack of data and resources. This can lead to increased uncertainty in the assessment of the relationship between wind turbine noise exposure and health outcomes. Based on all these factors, it may be concluded that the acoustical description of wind turbine noise by means of Lden or Lnight may be a poor characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes…*
>
> *…Further work is required to assess fully the benefits and harms of exposure to environmental noise from wind turbines and to clarify whether the potential benefits associated with reducing exposure to environmental noise for individuals living in the vicinity of wind turbines outweigh the impact on the development of renewable energy policies in the WHO European Region."*

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

Future Potential Guidance Change

In December 2019, the Draft Revised Wind Energy Development Guidelines December 2019 (referred to here as the Draft Guidelines) were published for consultation and therefore have yet to be finalised. It is important to note that as part of the public consultation a number of concerns in relation to the proposed approach have been expressed by various parties and it is the opinion of the authors' of this assessment that the Draft Guidelines document does not outline a best practice approach in terms of the assessment of wind turbine noise. Specific concerns expressed by a cross party group of interested professionals can be reviewed at:

> *https://www.ioa.org.uk/wind-energy-development-guidelines-wedg-consultation-irish-department-housing-planning-community-and*

The following statement is of note from the above submission:

> *"a number of acousticians working in the field have raised serious concerns over the significant amount of technical errors, ambiguities and inconsistencies in the content of the draft WEDG and these were highlighted during the consultation process by a group of acousticians".*

It is also noted that the Department has sought to commission a review of the guidelines.

Therefore, in line with best practice, which includes ESTU and IOA methodologies as described above the assessment presented in the EIAR is based on the current best practice guidance outlined in Section 5.6 of the WEDG

The original ETSU-R-97 concepts on which the WEDG is based underwent a thorough standardisation and modernisation in 2013 with the Institute of Acoustics publication of the A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise including 6 Supplementary Guidance Notes, all of which bring together the combined experience of acoustic consultants in the UK and Ireland in the application of these methods. Numerous improvements in the accuracy and robustness are described, in particular the treatment of wind shear and the general adaptation to larger wind turbines. The assessment in the EIAR takes cognisance of these amendments and is therefore in full accordance with the latest best-practice methods.

In the event that updated Wind Energy Development Guidelines are published during the application process for the Proposed Development it is anticipated that any relevant changes affecting the noise will be addressed through an appropriate planning condition, or where a supplementary assessment is necessary, through provision of additional information.

Permitted Development Planning Condition

Condition 8 of the grant of planning permission relates to noise and is as follows:

> *8. Noise mitigation measures outlined in the environmental impact statement and in the further information submitted to the planning authority shall be carried out in full. The following conditions shall be complied with:*
>
> *(a) Wind turbine noise arising from the proposed development, by itself or in combination with other existing or permitted wind energy development in the vicinity, shall not exceed the greater of:*
>
> - *5 dB(A) above background noise levels or*
> - *43 dB(A) $L_{90,10min}$*
>
> *when measured externally at dwellings or other sensitive receptors.*
>
> *(b) Prior to commencement of development, the developer shall submit to and agree in writing with the planning authority a noise compliance monitoring programme for the subject development, including any mitigation measures such as the de-rating of particular turbines. All noise measurements shall be carried out in accordance with ISO Recommendation R 1996 "Assessment of Noise with Respect to Community Response," as amended by ISO Recommendations R 1996-1. The results of the initial noise compliance monitoring shall be submitted to, and agreed in writing with, the planning authority within six months of commissioning of the wind farm.*
>
> *Reason: In the interest of residential amenity.*

The noise condition refers to cumulative wind turbine noise levels. The wording of the noise limits is such that if it can be demonstrated that the cumulative wind turbine noise level at a noise-sensitive location is 43 dB $L_{A90,10min}$ or less, then the noise level is compliant with the condition, without reference to the background noise levels.

12.2.2 Special Characteristics of Turbine Noise

12.2.2.1. Infrasound/Low Frequency Noise

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

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

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

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

In 2010, the UK Health Protection Agency published a report entitled Health Effects of Exposure to Ultrasound and Infrasound, Report of the independent Advisory Group on Non-ionising Radiation. The exposures considered in the report related to medical applications and general environmental exposure. The report notes:

> *"Infrasound is widespread in modern society, being generated by cars, trains and aircraft, and by industrial machinery, pumps, compressors and low speed fans. Under these circumstances, infrasound is usually accompanied by the generation of audible, low frequency noise. Natural sources of infrasound include thunderstorms and fluctuations in atmospheric pressure, wind and waves, and volcanoes; running and swimming also generate changes in air pressure at infrasonic frequencies.*
>
> *For infrasound, aural pain and damage can occur at exposures above about 140 dB, the threshold depending on the frequency. The best-established responses occur following acute exposures at intensities great enough to be heard and may possibly lead to a decrease in wakefulness. The available evidence is inadequate to draw firm conclusions about potential health effects associated with exposure at the levels normally experienced in the environment, especially the effects of long-term exposures. The available data do not suggest that exposure to infrasound below the hearing threshold levels is capable of causing adverse effects."*

The UK Institute of Acoustics Bulletin in March 2009 included a statement of agreement between acoustic consultants regularly employed on behalf of wind farm developers, and conversely acoustic consultants regularly employed on behalf of community groups campaigning against wind farm developments (IAO JS2009). The intent of the article was to promote consistent assessment practices, and to assist in restricting wind farm noise disputes to legitimate matters of concern. In relation to the issue of infrasound, the article states the following:

> *"Infrasound is the term generally used to describe sound at frequencies below 20 Hz. At separation distances from wind turbines which are typical of residential locations the levels of infrasound from wind turbines are well below the human perception level. Infrasound from wind turbines is often at levels below that of the noise generated by wind around buildings and other obstacles.*
>
> *Sounds at frequencies from about 20 Hz to 200 Hz are conventionally referred to as low-frequency sounds. A report for the DTI in 2006 by Hayes McKenzie concluded that neither infrasound nor low frequency noise was a significant factor at the separation distances at which people lived. This was confirmed by a peer review by a number of consultants working in this field. We concur with this view."*

The article concludes that:

> *"from examination of reports of the studies referred to above, and other reports widely available on internet sites, we conclude that there is no robust evidence that low frequency noise (including 'infrasound') or ground-borne vibration from wind farms, generally has adverse effects on wind farm neighbours".*

A report released in January 2013 by the South Australian Environment Protection Authority[1] namely, Infrasound levels near windfarms and in other environments (EPA, 2013) found that the level of infrasound from wind turbines is insignificant and no different to any other source of noise, and that the worst contributors to household infrasound are air-conditioners, traffic and noise generated by people.

The study included several houses in rural and urban areas, both adjacent to and away from a wind farm, and measured the levels of infrasound with the wind farms operating and switched off.

There were no noticeable differences in the levels of infrasound under all these different conditions. In fact, the lowest levels of infrasound were recorded at one of the houses closest to a wind farm, whereas the highest levels were found in an urban office building.

The EPA's study concluded that the level of infrasound at houses near wind turbines was no greater than in other urban and rural environments, and stated that:

> *"The contribution of wind turbines to the measured infrasound levels is insignificant in comparison with the background level of infrasound in the environment."*

A German report[2], titled "Low Frequency Noise incl. Infrasound from Wind Turbines and Other Sources" presents the details of a measurement project which ran from 2013. The report was published by the State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Württemberg in 2016 and concluded the following in relation to infrasound from wind turbines:

> *"The measured infrasound levels (G levels) at a distance of approx. 150 m from the turbine were between 55 and 80 dB(G) with the turbine running. With the turbine switched off, they*

[1] EPA South Australia, 2013, Wind farms https://www.epa.sa.gov.au/files/477912_infrasound.pdf

[2] Report available at https://www4.lubw.baden-wuerttemberg.de/servlet/is/262445/low-frequency_noise_incl_infrasound.pdf?command=downloadContent&filename=low-frequency_noise_incl_infrasound.pdf

were between 50 and 75 dB(G). At distances of 650 to 700 m, the G levels were between 55 and 75 dB(G) with the turbine switched on as well as off."

"For the measurements carried out even at close range, the infrasound levels in the vicinity of wind turbines – at distances between 150 and 300 m – were well below the threshold of what humans can perceive in accordance with DIN 45680 (2013 Draft) [3]"

"The results of this measurement project comply with the results of similar investigations on a national and international level."

In conclusion, there is a significant body of evidence to show that the infrasound associated with wind turbines will be below perceptibility thresholds and typically in line with existing baseline levels of infrasound within the environment.

12.2.2.2. Amplitude Modulation

In the context of this assessment, amplitude modulation (AM) is defined in the IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) document A Method for Rating Amplitude Modulation in Wind Turbine Noise (IOA, 2016) as:

"Periodic fluctuations in the level of audible noise from a wind turbine (or wind turbines), the frequency of the fluctuations being related to the blade passing frequency (BPF) of the turbine rotor(s)."

It is now generally accepted that there are two mechanisms which can cause amplitude modulation:

- 'Normal' AM, and;
- 'Other' AM (sometimes referred to 'Excessive' AM).

In both cases, the result is a regular fluctuation in amplitude at the Blade Passing Frequency (BPF) of the wind turbine blades (the rate at which the blades of the turbine pass a fixed point). For a three-bladed turbine rotating at 20 rpm, this equates to a modulation frequency of 1 Hz.

'Normal' AM

An observer at ground level close to a wind turbine will experience 'blade swish' because of the directional characteristics of the noise radiated from the trailing edge of the blades as it rotates towards and then away from the observer.

This effect is reduced for an observer on or close to the turbine axis, and therefore would not generally be expected to be significant at typical separation distances, at least on relatively level sites.

The RenewableUK AM project (RenewableUK, 2013) has coined the term 'normal' AM (NAM) for this inherent characteristic of wind turbine noise, which has long been recognised and was discussed in ETSU-R-97 in 1996.

'Other' AM

In some cases AM is observed at large distances from a wind turbine (or turbines). The sound is generally heard as a periodic 'thumping' or 'whoomphing' at relatively low frequencies.

On sites where it has been reported, occurrences appear to be occasional, although they can persist for several hours under some conditions, dependent on atmospheric factors, including wind speed and direction.

It was proposed in the RenewableUK 2013 study that the fundamental cause of this type of AM is transient stall conditions occurring as the blades rotate, giving rise to the periodic thumping at the blade passing frequency.

Transient stall represents a fundamentally different mechanism from blade swish and can be heard at relatively large distances, primarily downwind of the rotor blade.

The RenewableUK AM project report adopted the term 'Other AM' (OAM) for this characteristic. The terms 'enhanced' or 'excess' AM (EAM) have been used by others, although such definitions do not distinguish between the source mechanisms and presuppose a 'normal' level of AM, presumably relating back to blade swish as described in ETSU-R-97.

Frequency of Occurrence of AM

Research by Salford University commissioned by the Department of Environment Food and Rural Affairs (DEFRA), the Department of Business, Enterprise and Regulatory Reform (BERR) and the Department of Communities and Local Government (CLG) investigated the issue of AM associated with wind turbine noise. The results were reviewed and published in the report Research into Aerodynamic Modulation of Wind Turbine Noise (2007). The broad conclusions of this report were that aerodynamic modulation was only considered to be an issue at 4, and a possible issue at a further 8, of 133 sites in the UK that were operational at the time of the study and considered within the review. At the 4 sites where AM was confirmed as an issue, it was considered that conditions associated with AM might occur between about 7 and 15% of the time. It also emerged that for three out of the four sites the complaints have subsided, in one case due to the introduction of a turbine control system. The research has shown that AM is a rare and unlikely occurrence at operational wind farms.

It should be noted that AM is associated with wind turbine operation and it is not possible to predict an occurrence of AM at the planning stage. It should also be noted that it is a rare event associated with a limited number of wind farms. While it can occur, it is the exception rather than the rule.

RenewableUK Research Document states the following in relation to matter:

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"even on those limited sites where it has been reported, its frequency of occurrence appears to be at best infrequent and intermittent."

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"It has also been the experience of the project team that, even at those wind farm sites where AM has been reported or identified to be an issue, its occurrence may be relatively infrequent. Thus, the capture of time periods when subjectively significant AM occurs may involve elapsed periods of several weeks or even months."

[3] DIN 45680:2013-09 – Draft "Measurement and Assessment of Low-frequency Noise Emissions" November 2013

Page 61 Module F "There is nothing at the planning stage that can presently be used to indicate a positive likelihood of OAM occurring at any given proposed wind farm site, based either on the site's general characteristics or on the known characteristics of the wind turbines to be installed."

Assessment of AM

Research and Guidance in the area is ongoing with recent publications being issued by the Institute of Acoustics (IOA) Noise working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) namely, A Method for Rating Amplitude Modulation in Wind Turbine Noise (August 2016) (The Reference Method). The document proposes an objective method for measuring and rating AM. The AMWG does not propose what level of AM is likely to result in adverse community response or propose any limits for AM. The purpose of the group is simply to use existing research to develop a Reference Methodology for the measurement and rating of amplitude modulation.

The definition of any limits of acceptability for AM, or consideration of how such limits might be incorporated into a wind farm planning condition, is outside the scope of the AMWG's work and is currently the subject of a separate UK Government funded study. In the absence of published guidance to date, it is considered best practice to adopt the penalty an article published in the Institute of Acoustics publication Acoustics Bulletin (Vol. 42 No. 2 March/April 2017) titled, Perception and Control of Amplitude Modulation in Wind Turbines Noise.rating and assessment scheme contained in

Where it occurs, AM is typically an intermittent occurrence, therefore assessment may involve long-term measurements during the operational phase of the proposed development. The 'Reference Method' for measuring AM outlined in the IOA AMWG document will provide a robust and reliable indicator of AM and yield important information on the frequency and duration of occurrence, which can be used to evaluate different operational conditions including mitigation.

12.2.2.3. Comments on Human Health Impacts

Health effects of wind turbine noise are discussed in Chapter 14, Population and Human Health. The peer reviewed research outlined in Chapter 14 supports that there are no negative health effects on people with long term exposure to wind turbine noise.

12.2.3 Vibration

A report published in Germany by the State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Württemberg in 2016, "Low Frequency Noise incl. Infrasound from Wind Turbines and Other Sources", Conducted vibration measurements study for an operational Nordex N117 – 2.4 MW wind turbine. The report concluded that at distances of less than 300m from the turbine vibration levels had dropped so far that they could no longer be differentiated from the background vibration levels.

Considering the distances from nearest NSLs to any of the turbines in the Proposed Development (>500m) the level of vibration will be significantly below any thresholds for perceptibility. Therefore, vibration criteria have not been specified for the operational phase of the Proposed Development.

12.2.4 Turbine Noise Calculations

A series of computer-based prediction models have been prepared to quantify the noise level associated with the operation of the Proposed Development. This section discusses the methodology for the noise modelling process.

12.2.4.1. Noise Modelling Software

Proprietary noise calculation software was used for the purposes of this impact assessment. The selected software, DGMR iNoise Enterprise, calculates noise levels in accordance with ISO 9613: Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation, (ISO, 1996).

iNoise is a proprietary noise calculation package for computing noise levels and propagation of noise sources. iNoise calculates noise levels in different ways depending on the selected prediction standard. In general, however, the resultant noise level is calculated considering a range of factors affecting the propagation of sound, including:

- the magnitude of the noise source in terms of A weighted sound power levels (LWA);
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces;
- the hardness of the ground between the source and receiver;
- Attenuation due to atmospheric absorption; and
- Meteorological effects such as wind gradient, temperature gradient and humidity (these have significant impact at distances greater than approximately 400m).

12.2.4.2. Input Data and Assumptions

The calculation settings, input data and any assumptions made in the assessment are described in the following sections. Additional information relating to the noise model inputs and calculation settings is provided in Appendix 12-2.

12.2.4.3. Turbine Details

Table 12.4 details the co-ordinates of the 11 no. proposed turbines that are being considered in this assessment.

Table 12.4 Proposed Development Turbine Co-ordinates

Turbine Ref.	Coordinates – Irish Transverse Mercator (ITM)	
	Easting	Northing
T01	516,137	733,670
T02	516,053	733,980

Turbine Ref.	Coordinates – Irish Transverse Mercator (ITM)	
	Easting	Northing
T03	515,637	733,678
T05	515,363	734,036
T06	515,199	733,570
T07	514,875	733,361
T08	516,103	734,530
T09	515,090	734,468
T11	514,908	733,868
T13	515,865	734,285
T14	514,806	734,228

For the purposes of this assessment, two turbine technologies have been selected:

- the Enercon E138 with a hub height of 81m, and
- the Vestas V136 with a hub height of 82m.

Tables 12.5 and 12.6 detail the noise spectra used for noise modelling purposes for the Proposed Development.

Table 12.5 Sound Power Level Spectra Used for Enercon E138 at a hub height of 81m

Wind Speed (m/s)	Sound Power Level, dB at Octave Band Centre Frequency, Hz								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
4	76.3	83.5	89.2	91.6	93.8	90.5	80.4	73.6	97.9
5	81.3	87.9	92.8	95.8	97.6	94.2	85.2	67.4	101.8
6	85.3	91.6	95.9	99.3	100.7	97.5	89.0	71.6	105.1
7	86.8	92.7	96.3	99.7	101.8	98.2	89.8	72.7	105.9
8	87.8	93.3	96.2	99.4	102.0	98.5	90.4	73.5	106.0
9	88.2	93.4	96.0	99.2	102.0	98.7	90.9	73.5	106.0

Table 12.6 Sound Power Level Spectra Used for Vestas V136 at a hub height of 82m

Wind Speed (m/s)	Sound Power Level, dB at Octave Band Centre Frequency, Hz								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
4	75.2	83.2	88.0	89.9	88.7	84.5	77.3	67.0	94.7
5	80.2	88.1	93.0	94.8	93.6	89.4	82.2	71.9	99.6
6	84.1	91.8	96.5	98.3	97.2	93.1	86.2	76.1	103.2
7	84.9	92.5	97.2	99.0	97.9	93.8	86.9	76.9	103.9
8	85.0	92.6	97.2	99.0	97.9	93.9	87.0	77.3	103.9
9	85.2	92.6	97.2	99.0	97.9	93.9	87.2	77.5	103.9

An appraisal of the surrounding area around the site identified the potential for cumulative impacts from the operation of the Proposed Development in combination with other wind farms. The wind farms which are included in the noise assessment are listed below:

- Cloosh – Operational development of 22 turbines with an associated HH of 90m.
- Letterpeak – Operational development of 7 turbines with an associated HH of 78m.
- Uggool – Operational development of 16 turbines with an associated HH of 90m.
- Seecon – Operational development of 16 turbines with an associated HH of 90m.
- Lettercraffroe – Operational development of 8 turbines with an assumed HH of 80m.
- Knockalough – Operational of 11 turbines with an associated HH of 79.5m.
- Cloosh Extension – Proposed development of 9 turbines with assumed HH of 99m.
- Ardderroo - Proposed development of 25 turbines with HH of 103.5m.

The sound power levels for the wind farms listed above are presented in Appendix 12-3. The manufacturer's turbine sound power levels in the Table 12.5 and Table 12.6 are derived based on measurements in terms of the L_{Aeq} acoustic parameter[4]. In accordance with best practice guidance contained within the Institute of Acoustics Good Practice Guide (IOA GPG), an allowance for uncertainty in the measurement of turbine source levels of +2dB is added to all turbine sound power levels presented in the tables above.

Moreover, as explained in Section 12.2.1.2, appropriate guidance is couched in terms of a L_{A90} parameter. Best practice guidance in the IOA GPG states that "L_{A90} levels should be determined from calculated L_{Aeq} levels by subtraction of 2 dB". Therefore, a 2dB reduction has been applied to the noise model output. All predicted

[4] For details, see IEC 61400 Wind turbine generator systems – Part 11: Acoustic noise measurement techniques.

noise levels in this chapter are presented in terms of L_{A90}, i.e. this reduction of 2dB is included the values presented. In the interest of clarity, the levels presented in the tables above are the corrected levels following the adding and subtracting of 2dB.

Finally, best practice specifies that should any tonal component be present, a penalty shall be added to the predicted noise levels. The level of this penalty is described in ETSU-R-97[5] and is related to the level by which any tonal components exceed audibility. For the purposes of this assessment a tonal penalty has not been included within the predicted noise levels. A warranty will be provided by the manufacturers of the selected turbine to ensure that the noise output will not require a tonal noise correction under best practice guidance.

The predicted cumulative turbine noise level from the Proposed Development and contributing permitted and proposed developments in the area will be compared against the current planning conditions and any exceedances of the limits will be identified and assessed. Where necessary, appropriate mitigation measures will be outlined.

12.2.5 Study Area for Environmental Noise

The IOA GPG states the following in relation to the extent of the study area, in section 2.2:

> *The 'study area' for background noise surveys (and noise assessment) should, as a minimum, be the area within which noise levels from the proposed, consented and existing wind turbine(s) may exceed 35 dB L_{A90} at up to 10 m/s wind speed. (Note: unless stated, in this document the wind speed reference for noise data is the 10 metre standardised wind speed, derived from the wind speed at turbine hub height as explained in Section 2.6).*

If there were no other wind farms to be considered, the study area is simply the 35 dB L_{A90} noise contour at maximum sound power level for the turbine, due to the proposed development only. The inclusion of other wind farms in the noise model has the potential to increase predicted noise levels to above 35dB L_{A90} at a wider set of NSLs. In this instance, NSLs within the 25 dB contour for the proposed development only are included in the assessment; this reaches to approximately 3.3 km from any Proposed Development turbine.

The coordinates of the resulting 270 NSLs are presented in Appendix 12-4.

12.3. Baseline Conditions

An environmental noise survey to quantify the existing baseline noise environment at NSLs was conducted by Malachy Walsh Partners as part of the planning assessment for the Permitted Development. The details of the environmental baseline noise survey are presented in the following sections.

12.3.1 Wind Speed Measurement

In this instance, wind speeds were measured at 10m height above ground level. The IOA GPG, published at in the same year as the survey, formalised a number of emerging best practices in relation to the measurement and analysis of baseline noise levels for wind turbine noise assessments. One of the main recommendations was the derivation of the 'standardised 10m wind speed' based on wind speeds measured at stipulated heights above ground in order to give due consideration to the issue of wind shear. Up to that time, it was common practice, including in Ireland, to obtain this specific wind speed dataset by the measurement of wind speed directly at 10 m above ground with no correction of the issue of wind shear typically being applied.

The IOA GPG states that wind speeds measured directly at 10 m above ground can be used, once an appropriate correction is applied, as follows:

> *4.5.4 The following simplified method is proposed for ease of use: applying a fixed correction by subtracting the following factors from the wind speed reference used in the turbine predictions: 1 m/s for turbine hub heights of up to 30 m, 2 m/s for hub heights of up to 60 m and 3 m/s for hub heights of more than 60 m. Such a generic approach would be suitable in the context of a study made using a 10 m mast to limit costs, in the absence of site-specific data.*
>
> *4.5.5 If it can be demonstrated that the predicted levels are below the applicable lower fixed limits regardless of wind speed, it can be seen that wind shear would not have an effect on the assessment, and this may form the basis of a suitable planning condition.*

In Chapter 10 of the submitted EIS for the Permitted Development a correction of 3 m/s was applied to the predicted noise levels in the noise assessment, in accordance with Section 4.5.4 of the IOA GPG. The parameters and findings of the noise surveys summarised in the following sections.

12.3.2 Choice of Measurement Locations

Coordinates for the two noise monitoring locations are detailed in Table 12.7 and illustrated in Figure 11.2.

Table 12.7 Measurement Location Coordinates

Location	Coordinates – Irish Transverse Mercator (ITM)	
	Easting	Northing
H002	517139	734232
H157	514269	732026

[5] UK Department of Trade and Industry: ETSU-R-97 The assessment of rating of Noise from wind farms, 1996

Figure 12.2 Indicative measurement locations

12.3.3 Measurement Periods

Noise measurements were conducted at each of the monitoring locations over the periods outlined in

Table 12.8 Measurement Periods

Location	Start Date	End Date
H002 (N1 in EIS)	14 May 2013	23 May 2013
H157 (N2 in EIS)	14 May 2013	23 May 2013

A variety of wind speed and weather conditions were encountered over the survey periods in question.

12.3.4 Background Noise Levels

12.3.4.1. Location H002

Daytime Periods

The background noise levels measured at H002, which was named N1 in the original EIS, are presented in Figure 12.3 or daytime periods.

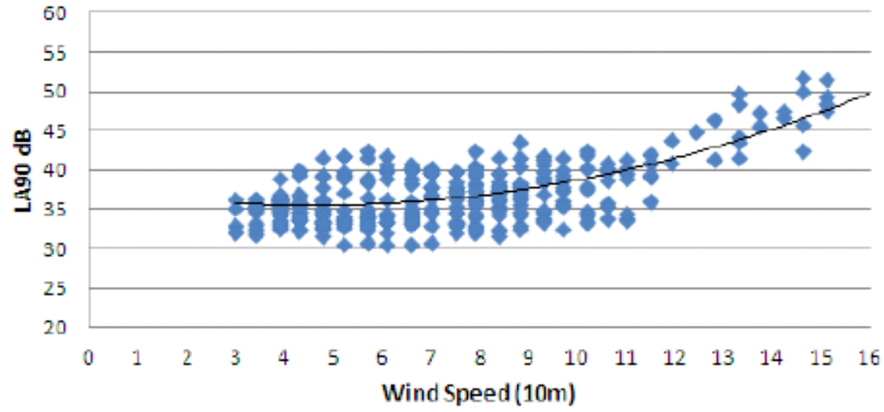

Figure 12.3 Location H002 Background Noise Levels LA90, 10 min dB – Daytime

Night-time Periods

The background noise levels measured at H002 are presented in Figure 12.4 for night-time periods.

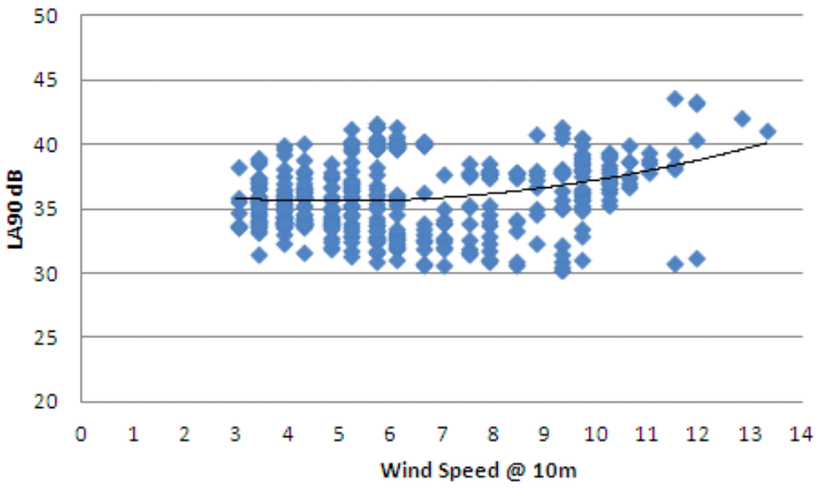

Figure 12.4 Figure 12.1 Location H002 Background Noise Levels $L_{A90,\ 10\ min}$ dB – Night-time

12.3.4.2. Location H157

Daytime Periods

The background noise levels measured at H157, which was named N2 in the original EIS, are presented in Figure 12.5 for daytime periods.

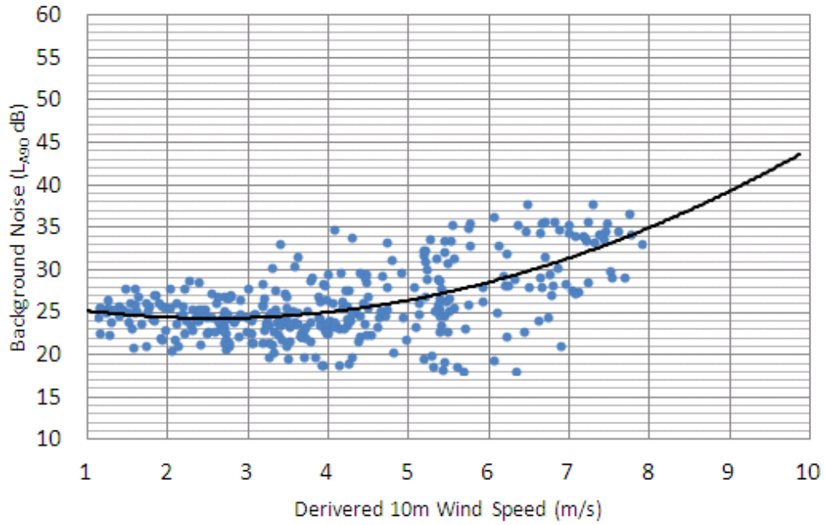

Figure 12.5 **Location H157 Background Noise Levels $L_{A90,\ 10\ min}$ dB – Daytime**

Night-time Periods

The background noise levels measured at H157 are presented in Figure 12.6 for night-time periods.

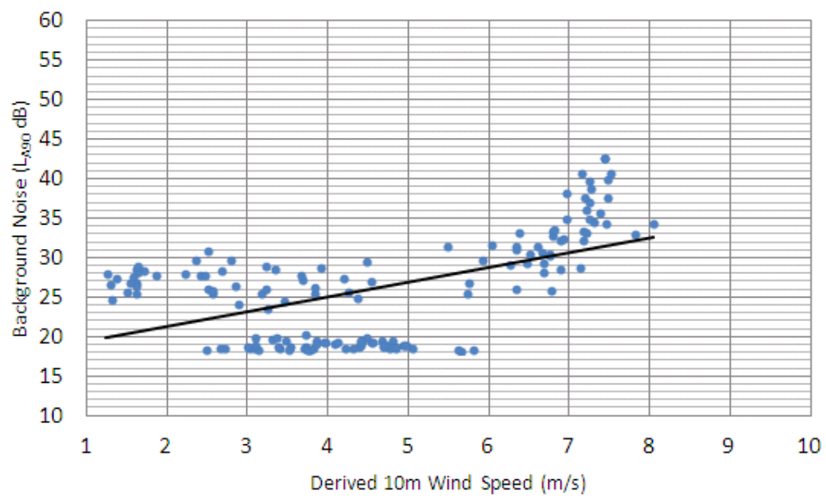

Figure 12.6 **Figure 12.2 Location H157 Background Noise Levels $L_{A90,\ 10\ min}$ dB – Night-time**

12.3.4.3. Wind Turbine Noise Criteria

The noise condition for the Permitted Development (See Section 12.2.1.2) are stated as "the greater of 43 dB L_{A90} or background + 5 dB". On review of the measured background noise levels, it is clear if predicted noise levels are 43 dB L_{A90} or less, then compliance with this planning condition is demonstrated. The wind turbine noise criteria are, therefore, for both day and night-time periods:

Table 12.9 **Wind Turbine Noise Criteria**

Wind Turbine Noise Criteria (dB L_{A90}) at standardised Wind Speed at 10 m above ground level						
3	4	5	6	7	8	9
43	43	43	43	43	43	43

Moreover, as the noise criterion is constant with respect to wind speed, the effect of wind shear does not have an effect on the assessment, and the fact that wind speeds were measured directly at 10m in the baseline noise survey, is not at concern.

12.4. Likely Significant Impacts

12.4.1 Do Nothing Scenario

If the Proposed Development were not to proceed the already permitted 11-turbine layout will proceed under the terms of the Galway County Council Planning Ref. No. 13/829 and An Bord Pleanála Ref: 07.243094 planning permissions. The opportunity to increase the energy output from County Galway's valuable renewable energy resource would be lost, as would the opportunity to further contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions.

12.4.2 Assessment of Effects During Construction

The construction phase noise impacts of the Permitted Development were assessed in the EIS submitted with that planning application. This Proposed Development seeks to increase the overall height of the permitted 11 no. wind turbines from a combination of 130.5m and 140.5m to 150m with associated turbine foundation alteration, omission of the permitted on-site substation, alteration to the underground cabling connection including road upgrade and provision of a new cable service track, and extension to the Ardderroo Substation to facilitate the revised grid connection.

The EIS for the Permitted Development fully assessed the likely significant effects of the 11 no. turbine layout and proposed mitigation measures to avoid or reduce these effects. The findings of the assessment and proposed mitigation measures will not be altered as a result of the Proposed Development.

12.4.2.1. Turbines and Hardstands

The construction phase noise impacts of the Permitted Development were assessed in the EIS submitted with that planning application. The EIS for the Permitted Development fully assessed the likely significant effects of the 11-turbine layout and proposed mitigation measures to avoid or reduce these effects. The findings of the assessment and proposed mitigation measures will not be altered as a result of the Proposed Development.

In terms of these the construction activities, the overall associated effects remain negative, not significant and short-term.

12.4.2.2. Grid Connection Route

The Proposed Development includes underground electrical and communications cabling connecting the 11 no. wind turbines to the Ardderroo substation, as well as extension to substation control building and new step up transformer. The underground cabling will be provided from within the wind farm roads, widened forestry road, and the new cable service track along the southern verge of the road serving Ardderroo substation.

The nearest noise-sensitive location to this element of the works are H152 and H154 at a distance of the order of 2.6 km.

Due to the nature of construction activities, it is difficult to calculate the actual magnitude of noise emissions to the local environment. However, the standard best practice approach used to predict typical noise levels at the nearest sensitive receptor is by using guidance set out in BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.

The methodology adopted for the assessment of construction noise is to analyse the various elements of the construction phase in isolation. For each element, the typical construction noise sources are assessed along with typical sound pressure levels and spectra from BS 5228 at various distances from these works.

The noise levels referred to in this section are indicative only and are intended to assess whether it is likely that the contractor can comply with current best practice guidance. The predicted levels are expected to occur for only short periods of time at a very limited number of properties. Construction noise levels will be lower than these levels for most of the time at most properties in the vicinity of the Proposed Development site.

Several indicative sources that would be expected on a site of this nature have been identified and noise predictions of their potential impacts prepared to nearby houses.; construction noise levels will be lower at properties located further from the works.

Table 12.10 details the noise levels associated with typical construction noise sources assessed in this instance along with typical sound pressure levels and spectra from BS 5228 – 1: 2009. Calculations have assumed an on-time of 66% for each item of plant i.e. 8 hours over a 12-hour assessment period.

Table 12.10 Noise Levels due to grid connection construction

Item (BS5228 Ref)	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) 6	Highest Predicted Noise Level at Stated Distance from Edge of Works (dB $L_{Aeq,T}$)			
		1000 m	1500 m	2000 m	2500 m
HGV Movement (C.2.30)	79	31	27	24	22
Tracked Excavator (C.4.64)	77	29	25	22	20
Dumper Truck (C.4.4)	76	28	24	21	19
Vibrating Rollers (D.8.29)	77	29	25	22	20
Generator (C.2.44)	77	29	25	22	20
Total Construction Noise (cumulative for all activities)		36	32	29	27

These levels of noise are well within the construction noise criterion outlined in Table 12.1, therefore it is concluded that there will be no significant noise impact associated with the construction of the grid connection, therefore no specific mitigation measures are required.

12.4.2.3. Substation

The Proposed Development proposes to omit the permitted on-site substation and instead connect the proposed wind turbines to the electrical grid at Ardderroo substation, as discussed in the previous section. An extension of the Ardderroo substation will be constructed to accommodate grid connection to Knockranny wind farm. The overall noise emission from the substation will be similar to the permitted substation therefore no significant noise or vibration effects due to the substation extension are likely.

12.4.2.4. Additional Traffic along Turbine Delivery Route

In respect of the potential noise effects of additional traffic of surrounding roads, the following comments are made for the construction phase, the assessment and findings in the EIS for the Permitted Development remain applicable and valid with the exception of traffic during the concrete pouring phase.

[6] All plant noise levels are derived from BS 5228: Part 1

However, as a result of the increased size of the foundations due to the increase in size of the turbines as part of the Proposed Development, additional concrete deliveries will be made to the site. The information presented in Chapter 5 has been used to inform the assessment of the updated traffic flows for this phase of the construction.

Changes in traffic noise levels along the proposed route have been estimated and presented in Table 12.11.

Table 12.11 Estimated Changes in Traffic Noise Levels during Construction Phase

Link	Change in noise levels due to permitted development dB $L_{Aeq, 12\ hr}$	Change in noise levels due to proposed development dB $L_{Aeq,12\ hr}$	Significance of Effect for Proposed Development
N59 National Secondary Road - Southeast	0.4	0.5	Imperceptible
N59 National Secondary Road - Northwest	0.3	0.4	Imperceptible
L-53453	4	4.4	Slight to Moderate

Based on the criteria in Table 12.2, the associated effect with the Proposed Development is negative, slight to moderate and short-term, just as it is for the Permitted Development.

In respect of the remaining phases, which are delivery of large equipment and other deliveries, the traffic flows are the same as those for the Permitted Development. The effects remain negative, slight and short-term.

12.4.3 Assessment of Effects During Operation

The noise levels for the Proposed Development site have been calculated for all noise sensitive receivers identified within the EIAR Study Area for noise as described in Section 12.2.5.

Note that this assessment refers to a cumulative situation as required by the IOA GPG:

> 5.1.4 *During scoping of a new wind farm development consideration should be given to cumulative noise impacts from any other wind farms in the locality. If the proposed wind farm produces noise levels within 10 dB of any existing wind farm/s at the same receptor location, then a cumulative noise impact assessment is necessary.*

As such a noise impact assessment considering the Proposed Development in isolation is not included. The results of the cumulative assessment are presented in the sections below, where two scenarios are considered, each representing one of the two candidate turbine technologies (E138 and V136).

12.4.3.1. Enercon E138

Using the sound power levels in Table 12.5, the cumulative noise levels at all 270 NSLs have been calculated in accordance with the guidance in section 12.2.1.2. The full set of predicted noise levels is presented in Appendix 12-5. For brevity, the noise levels are presented in Table 12.12 for a subset of locations, being the closest NSLs in different directions from the Proposed Development.

Table 12.12 Review of Cumulative Predicted Turbine Noise Levels against Relevant Criteria (E138)

House (at distance, m)	Parameter	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	9
H001 (1099m)	Predicted	29.7	33.7	37.1	37.9	38.0	38.0
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H002 (1073m)	Predicted	29.6	33.6	37.0	37.9	38.0	38.0
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H003 (1034m)	Predicted	29.9	33.9	37.3	38.1	38.2	38.2
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H065 (1627m)	Predicted	25.8	29.9	33.4	34.4	34.5	34.5
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H066 (1672m)	Predicted	24.9	28.9	32.4	33.4	33.5	33.5
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H067 (1660m)	Predicted	25.7	29.8	33.3	34.3	34.4	34.4
	Criterion	43	43	43	43	43	43

House (at distance, m)	Parameter	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	9
	Excess	--	--	--	--	--	--
H068 (1623m)	Predicted	25.9	30.0	33.5	34.5	34.6	34.6
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H152 (2226m)	Predicted	23.3	27.5	31.1	32.2	32.4	32.4
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H154 (2178m)	Predicted	23.5	27.6	31.2	32.3	32.5	32.5
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H156 (2352m)	Predicted	23.2	27.4	31.1	32.2	32.4	32.4
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H157 (1467m)	Predicted	29.7	34.1	38.0	39.4	39.6	39.6
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H158 (1550m)	Predicted	29.4	33.8	37.7	39.2	39.4	39.4
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H159 (1697m)	Predicted	28.9	33.3	37.2	38.8	39.0	39.0
	Criterion	43	43	43	43	43	43

House (at distance, m)	Parameter	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	9
	Excess	--	--	--	--	--	--
H160 (1778m)	Predicted	28.6	33.0	37.0	38.5	38.7	38.7
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H167 (1161m)	Predicted	28.2	32.3	35.9	36.9	37.1	37.1
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H168 (1214m)	Predicted	27.8	31.9	35.5	36.6	36.7	36.7
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H169 (1226m)	Predicted	27.9	32.0	35.6	36.6	36.8	36.8
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H170 (1305m)	Predicted	27.3	31.4	35.1	36.2	36.4	36.4
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H173 (1572m)	Predicted	25.3	29.4	33.1	34.2	34.4	34.4
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H174 (1629m)	Predicted	25.0	29.1	32.8	34.0	34.2	34.2
	Criterion	43	43	43	43	43	43

House (at distance, m)	Parameter	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	9
	Excess	--	--	--	--	--	--
H175 (1686m)	Predicted	25.1	29.2	32.8	34.0	34.2	34.2
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--

Contours of noise levels for E138 standard mode operation rated power wind speed (i.e. highest noise emission) have been presented in Appendix 12-6. The predicted noise levels for all turbines operating in standard mode shows that all predicted noise levels are within the planning criterion of 43 dB L_{A90}.

With respect to the EPA criteria for description of effects, the potential predicted effects at the nearest noise sensitive locations associated with the operation of the wind turbines is negative, moderate and long-term.

12.4.3.2. Vestas V136

Using the sound power levels in Table 12.6, the cumulative noise levels at all 270 NSLs have been calculated in accordance with the guidance in section 12.2.1.2. The full set of predicted noise levels is presented in Appendix 12-7. For brevity, the noise levels are presented in Table 12.6 for a subset of locations, being the closest NSLs in different directions from the Proposed Development.

Table 12.13 Review of Cumulative Predicted Turbine Noise Levels against Relevant Criteria (V136)

House (at distance, m)	Parameter	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	9
H001 (1099m)	Predicted	27.4	32.3	35.9	36.8	36.8	36.8
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H002 (1073m)	Predicted	27.4	32.2	35.9	36.7	36.8	36.8
	Criterion	43	43	43	43	43	43
H003 (1034m)	Predicted	27.6	32.5	36.1	36.9	37.0	37.0
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H065 (1627m)	Predicted	24.2	29.0	32.7	33.7	33.8	33.8
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H066 (1672m)	Predicted	23.2	28.0	31.7	32.7	32.8	32.8
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H067 (1660m)	Predicted	24.1	28.9	32.6	33.6	33.7	33.7
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H068 (1623m)	Predicted	24.3	29.1	32.8	33.8	33.9	33.9
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H152 (2226m)	Predicted	22.3	27.1	30.9	32.0	32.1	32.1
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H154 (2178m)	Predicted	22.3	27.1	30.9	32.0	32.2	32.2
	Criterion	43	43	43	43	43	43

House (at distance, m)	Parameter	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	9
	Excess	--	--	--	--	--	--
H156 (2352m)	Predicted	22.1	26.9	30.7	31.9	32.1	32.1
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H157 (1467m)	Predicted	28.9	33.7	37.6	39.1	39.3	39.3
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H158 (1550m)	Predicted	28.6	33.4	37.4	38.9	39.1	39.1
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H159 (1697m)	Predicted	28.2	33.0	37.0	38.5	38.8	38.8
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H160 (1778m)	Predicted	28.0	32.7	36.7	38.3	38.5	38.5
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H167 (1161m)	Predicted	26.4	31.2	35.0	36.1	36.3	36.3
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H168 (1214m)	Predicted	26.1	30.9	34.7	35.8	36.0	36.0
	Criterion	43	43	43	43	43	43

House (at distance, m)	Parameter	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m A.G.L.					
		4	5	6	7	8	9
	Excess	--	--	--	--	--	--
H169 (1226m)	Predicted	26.0	30.8	34.7	35.8	36.0	36.0
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H170 (1305m)	Predicted	25.6	30.4	34.3	35.5	35.7	35.7
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H173 (1572m)	Predicted	23.8	28.5	32.4	33.6	33.8	33.8
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H174 (1629m)	Predicted	23.6	28.3	32.2	33.4	33.6	33.6
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--
H175 (1686m)	Predicted	23.6	28.3	32.2	33.4	33.6	33.6
	Criterion	43	43	43	43	43	43
	Excess	--	--	--	--	--	--

Contours of noise levels the V136 for standard mode operation rated power wind speed (i.e. highest noise emission) have been presented in Appendix 12-8. The predicted noise levels for all turbines operating in standard mode shows that all predicted noise levels are within the planning criterion of 43 dB L_{A90}.

With respect to the EPA criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive locations associated with the operation of the wind turbines is negative, moderate and long-term.

12.4.3.3. Comparison of Proposed Development with Permitted Development

Table 12.14 compares the predicted cumulative noise levels due to the Permitted Development with the proposed development. Note that the values in the 'Permitted' column have been calculated with the GE 2.85 MW turbine at a hub heights of 80 and 90 m, and that the calculations include the other wind farms as listed in Section 12.2.4.3. Therefore the predicted noise levels differ slightly from those in the EIS associated with the Permitted Development.

In the case of the E138, the predicted changes in noise levels are -0.6 to -0.1 dB and for the V136, the changes are 0.0 to +0.2 dB. In both cases, the differences in predicted noise levels between the Permitted Development and either scenario for the Proposed Development are imperceptible.

Table 12.14 Review of differences in predicted noise levels at 8 m/s wind speed at standardised 10m height

Name	Predicted noise levels at 8 m/s wind speed at standardised 10m height				
	Permitted	E138	E138 vs Permitted	V136	V136 Vs Permitted
H001	36.8	38.0	+1.2	36.8	0.0
H002	36.7	38.0	+1.3	36.8	+0.1
H003	37.0	38.2	+1.2	37.0	0.0
H065	33.8	34.5	+0.7	33.8	0.0
H066	32.7	33.5	+0.8	32.8	+0.1
H067	33.6	34.4	+0.8	33.7	+0.1
H068	33.8	34.6	+0.8	33.9	+0.1
H152	32.2	32.4	+0.2	32.1	-0.1
H154	32.2	32.5	+0.3	32.2	0.0
H156	32.2	32.4	+0.2	32.1	-0.1
H157	39.6	39.6	0.0	39.3	-0.3
H158	39.4	39.4	0.0	39.1	-0.3
H159	39.0	39.0	0.0	38.8	-0.2
H160	38.8	38.7	-0.1	38.5	-0.3
H167	36.3	37.1	+0.8	36.3	0.0
H168	36.0	36.7	+0.7	36.0	0.0
H169	36.0	36.8	+0.8	36.0	0.0
H170	35.7	36.4	+0.7	35.7	0.0
H173	33.7	34.4	+0.7	33.8	+0.1
H174	33.5	34.2	+0.7	33.6	+0.1
H175	33.6	34.2	+0.6	33.6	0.0

12.5. Mitigation Measures and Monitoring

12.5.1 Construction Phase

As the wind turbine construction methods will be the same as those for the Permitted Development, the mitigation measures presented in the previous EIS apply also to the Proposed Development, re-iterated here:

Reference will be made to British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise, which offers detailed guidance on the control of noise & vibration from demolition and construction activities. The following best practices will be employed:

- limiting the hours during which site activities likely to create high levels of noise or vibration are permitted;
- establishing channels of communication between the contractor/developer, Local Authority and residents;
- appointing a site representative responsible for matters relating to noise and vibration;
- monitoring typical levels of noise and vibration during critical periods and at sensitive locations;
- keeping site access roads even to mitigate the potential for vibration from lorries.
- selection of plant with low inherent potential for generation of noise and/ or vibration;
- placing of noisy / vibratory plant as far away from sensitive properties as permitted by site constraints, and;
- regular maintenance and servicing of plant items.

12.5.1.1. Noise

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

Noise. The following list of measures will be considered, where necessary, to ensure compliance with the relevant construction noise criteria:

- No plant used on site will be permitted to cause an on-going public nuisance due to noise.
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
- Any plant, such as generators or pumps, which is required to operate outside of general construction hours will be surrounded by an acoustic enclosure or portable screen.
- During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Table 12.1 using methods outlined in British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.
- The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 7:00hrs and 19:00hrs Monday to Saturday. However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (i.e., concrete pours, rotor/blade lifting) it could occasionally be necessary to work out of these hours.

Where rock breaking is employed, the following are examples of measures that will be employed, to mitigate noise emissions from these activities:

- Fit suitably designed muffler or sound reduction equipment to the rock breaking tool to reduce noise without impairing machine efficiency.
- Ensure all leaks in air lines are sealed.
- Use a dampened bit to eliminate ringing.
- Erect acoustic screen between compressor or generator and noise sensitive area. When possible, line of sight between top of machine and reception point needs to be obscured.
- Enclose breaker or rock drill in portable or fixed acoustic enclosure with suitable ventilation.

12.5.2 Operational Phase

An assessment of the operational noise levels has been undertaken in accordance with best practice guidelines and procedures as outlined in Section 12.2.1.2 of this Chapter. The findings of the assessment confirmed that the predicted operational noise levels will be within the relevant best practice noise criteria curves for wind farms at all locations and therefore no mitigation measures are required.

If alternative turbine technologies are considered for the site an updated noise assessment will be prepared to confirm that the noise emissions associated with the selected turbines will comply with the relevant operational criteria associated with the grant of planning for the Proposed Development. If necessary, suitable curtailment strategies will be designed and implemented for alternative technologies to ensure compliance with the relevant noise criteria curves, should detailed assessment conclude that this is necessary.

In the unlikely event that an issue with low frequency noise is associated with the Proposed Development, it is recommended that an appropriate detailed investigation be undertaken. Due consideration should be given to guidance on conducting such an investigation which is outlined in Appendix VI of the EPA document entitled Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (EPA, 2016). This guidance is based on the threshold values outlined in the Salford University document Procedure for the assessment of low frequency noise complaints, Revision 1, December 2011.

In the unlikely event that a complaint is received which indicates potential amplitude modulation (AM) associated with turbine operation, the operator shall employ an independent acoustic consultant to assess the level of AM in accordance with the methods outlined in the Institute of Acoustics (IOA) Noise working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) namely, A Method for Rating Amplitude Modulation in Wind Turbine Noise (August 2016) or subsequent revisions.

The measurement method outlined in the IOA AMWG document, known as the 'Reference Method', will provide an indicator of AM and yield important information on the frequency and duration of occurrence, which can be used to evaluate different operational conditions including mitigation.

12.5.2.1. Monitoring

Commissioning noise surveys are recommended to ensure compliance with any noise conditions applied to the Proposed Development. In the unlikely instance that an exceedance of these noise criteria is identified, the assessment guidance outlined in the IOA GPG and *Supplementary Guidance Note 5: Post Completion Measurements (July 2014)* should be followed and relevant corrective actions will be taken if deemed necessary. For example, implementation of noise operational modes resulting in curtailment of turbine operation can be implemented for specific turbines in specific wind conditions to ensure predicted noise levels are within the relevant noise criterion curves/planning conditions.

Post-commissioning of the Proposed Development turbines, it is recommended that the noise monitoring detailed in the relevant section of this report be repeated with consideration of the guidance outlined in the IOA GPG and Supplementary Guidance Note 5.

12.5.3 Decommissioning Phase

In relation to the decommissioning phase, similar overall noise levels as those calculated for the construction phase would be expected, as similar tools and equipment will be used. The noise and vibration impacts associated with any decommissioning of the wind turbines are considered to be comparable to those outlined in relation to the construction of the Permitted Development. With reference to the Construction Environmental Management Plan, there is no item of plant that would be expected to give rise to noise levels that would be considered out of the ordinary or in exceedance of the levels outlined in Section 12.2.1.1.

Considering that in all aspects of the construction and decommissioning the predicted noise levels are expected to be below the appropriate Category A value (i.e., 65dB $L_{Aeq,T}$) at current noise sensitive locations for the decommissioning phase, therefore the noise and vibration effects are not significant.

12.5.3.1. Decommissioning Phase Mitigation

The mitigation measures that will be considered in relation to any decommissioning of the site are the same as those proposed for the construction phase of the development, i.e., as per Section 12.4.2.

12.6. Residual Effects

12.6.1 Construction Phase

During the construction phase of the project there will be some effect on nearby NSLs due to noise emissions from site traffic and other construction activities. However, given the distances between the main construction works and nearby NSLs and the fact that the construction phase of the development is short-term in nature, it is expected that the various noise sources will not be excessively intrusive. Furthermore, the application of binding noise limits and hours of operation, along with implementation of appropriate noise and vibration control measures, will ensure that the noise and vibration effect is kept to a minimum.

With respect to the EPA's criteria for description of effects, in terms of these construction activities, the potential worst-case associated effects at the nearest NSLs associated with the various elements of the construction phase are negative, not significant and short-term.

12.6.2 Operational Phase

The predicted noise levels associated with the Proposed Development will be within best practice noise criteria curves recommended in Irish guidance '*WEDG*' therefore, it is not considered that a significant effect is associated with the Proposed Development.

The predicted residual operational noise effects are summarised as follows: negative, moderate and long-term

12.7. Cumulative Effects

12.7.1 Wind Farm Developments

12.7.1.1. Construction Phase

In general, potential construction noise impacts may occur if other developments are constructed at the same time as the proposed development. In this instance, the closest other wind farm included in the cumulative assessment is Ardderroo, which is already partially constructed; similarly, the next nearest wind farms, Uggool and Cloosh and Knockalough are also operational.

Due to the distances between NSLs considered here and the other wind farms yet to be constructed, is not considered that significant cumulative noise and vibration effects are likely.

Forestry operations on the site will be concurrent with the construction phase but are not expected to have a significant cumulative noise effect.

12.7.1.2. Operational Phase

The noise assessment presented in this EIAR chapter is inherently an assessment of cumulative wind turbine noise, as required by the IOA GPG.

12.7.2 Other Developments

Development other than wind farms are considered here are as follows:

- The proposed N59 Maigh Cullinn (Moycullen) Bypass Road Project
- The Connemara Greenway

12.7.2.1. N59 Maigh Cullinn (Moycullen) Bypass

Due to the distances between the NSLs considered in this assessment and the proposed Moycullen bypass, it is considered that cumulative effects are not significant for either the construction or operational phases.

12.7.2.2. Connemara Greenway

The Connemara Greenway passes to the east of the NSLs used in this assessment. NSLs along the N59 are at distances of the order of 2.5 km from the proposed development; similarly, distances are such that there is no likelihood of a significant cumulative impact due to the construction of the greenway. In the operational phase, the greenway is not expected to generate any significant noise and cannot therefore lead to a significant cumulative noise impact with the proposed development.

In addition to the above, there will do no significant cumulative impacts with local domestic/agricultural projects identified in Chapter 1.

12.8. Difficulties Encountered in Compiling Information

None.

12.9. References

EPA Guidelines on the Information to be contained in Environmental Impact Statements, (EPA, 2022);

EPA Advice Notes for Preparing Environmental Impact Statements, (Draft, September 2015);

BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.

BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 2 – Vibration.

BS 7385-2:1993 Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration;

Design Manual for Roads and Bridges LA 111 Sustainability & Environmental Appraisal. Noise and Vibration Rev 2 (2020);

ISO 1996: 2017: Acoustics – Description, measurement and assessment of environmental noise.

World Health Organisation Environmental Noise Guidelines for the European Region, 2018

Institute of Acoustics: A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (2013)

Wind Energy Development Guidelines" published by the Department of the Environment, Heritage and Local Government 2006

Department of Trade & Industry (UK) Energy Technology Support Unit (ETSU) "The Assessment and Rating of Noise from Wind Farms" (1996).

CNOC RAITHNÍ (KNOCKRANNY) WIND FARM

CHAPTER 13

Air Quality and Climate

VOLUME II EIAR

CHAPTER 13 – Air & Climate

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Chapter 13

13. AIR QUALITY AND CLIMATE

13.1. Introduction

This chapter assesses the air quality and climate likely significant environmental effects of the Proposed Development. A detailed description of the development is provided in Chapter 2 of this EIAR.

The subject site is located approximately 4.5 kilometres north-west of the settlement of Moycullen and c.2.5 kilometres west of the N59 (Galway – Clifden) National Secondary Road. The site is accessed via county road from the N59 and a secondary road, from the north and west. The area in the vicinity of the site is a remote upland area interspersed with hills with rough grazing generally to the east, forestry, and turf cutting on bogland areas.

There are a large number of existing, extant and proposed wind farms located within c. 10 km of the site located on a mix of bogland (mix of cutover and bog/heath habitat) and within commercial forestry plantations. The site is located immediately east of Ardderroo Wind Farm (25 turbines) which is under construction.

13.2. Assessment Methodology

13.2.1. Air Quality Standards and Policy

Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable standards in Ireland include the Air Quality Standards Regulations 2022, which incorporate the European Commission Directive 2008/50/EC (on ambient air quality and cleaner air for Europe). Council Directive 2008/50/EC (CAFÉ Directive) combines the previous Air Quality Framework Directive (96/62/EC) and its subsequent daughter directives (including 1999/30/EC and 2000/69/EC) and also includes ambient limit values relating to Particulate Matter (as $PM_{2.5}$).

The limit values or "Air Quality Standards" are health or environmental-based levels and for which additional factors may be considered. For example, natural background levels, environmental conditions and socio-economic factors may all play a part in the limit value which is set (see Table 13.1).

The World Health Organization (WHO) has published Air Quality Guidelines for the protection of human health (hereafter referred to as the WHO Guidelines) (WHO 2006 and 2021). The WHO Guidelines detail values relating to NO_2, PM_{10} and $PM_{2.5}$. The 2005 WHO Guideline values are more stringent than the European Union (EU) statutory limit values for PM_{10} and $PM_{2.5}$, with the 2021 updates further reducing recommended concentrations. In relation to NO_2, the compliance limit values are equivalent.

However, the WHO one-hour guideline value for NO_2 is an absolute value while the EU standards allows this limit to be exceeded for 18 hours / annum without breaching the statutory limit value. The WHO recognize that these levels are essentially unachievable in most countries and indeed also provides interim targets in the years when the full guideline aim to be achieved. It should be noted that the targets are intended for populations rather than for individual receptors. The guidelines (WHO 2021) state:

> *"Currently, the accumulated evidence is sufficient to justify actions to reduce population exposure to key air pollutants, not only in particular countries or regions but on a global scale."*

For the purposes of this assessment, the appropriate limits for the assessment of air quality impacts are those outlined the Air Quality Standards Regulations 2022.

Pollutant	Regulation	Limit Type	Value
Nitrogen Dioxide (NO_2)	S.I. 739 of 2022	Hourly limit for protection of human health - not to be exceeded more than 18 times / year	200 µg/m^3 NO_2
	S.I. 739 of 2022	Annual limit for protection of human health	40 µg/m^3 NO_2
Nitrogen Oxides (NO + NO_2)	S.I. 739 of 2022	Critical limit for the protection of vegetation and natural ecosystems	30 µg/m^3 NO + NO_2
Particulate Matter (as PM_{10})	S.I. 739 of 2022	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 µg/m^3 PM_{10}
Particulate Matter (as PM_{10})		Annual limit for protection of human health	40 µg/m^3 PM_{10}
Particulate Matter (as $PM_{2.5}$)	S.I. 739 of 2022	Annual limit for protection of human health	25 µg/m^3 $PM_{2.5}$

Table 13.1 Air Quality Standards Regulations 2022 (based on EU Council Directive 2008/50/EC)

The concern from a health perspective is focused on particles of dust which are less than 10 microns and the EU ambient air quality standards have set ambient air quality limit values for PM_{10} and $PM_{2.5}$ for protection of human health.

Larger dust particles can give rise to dust that causes a nuisance, in Ireland there are no statutory guidelines regarding the maximum dust deposition levels that may be generated during the construction phase of a development.

The Verein Deutscher Ingenieure (VDI) German Technical Instructions on Air Quality Control – TA Luft standard for dust deposition (German VDI, 2002) (non-hazardous dust) sets a maximum permissible emission level for dust deposition of 350 mg/m^2/day averaged over a one-year period at any receptors outside the site boundary. Recommendations from the Department of the Environment, Heritage & Local Government (DEHLG, 2004) apply the Bergerhoff limit of 350 mg/m^2/day to the site boundary of quarries. This limit value can be implemented with regard to dust impacts from construction works.

13.2.1.2. Gothenburg Protocol

In 1999, Ireland signed the Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution. In 2012, the Gothenburg Protocol was revised to include national emission reduction commitments for the main air pollutants to be achieved in 2020 and beyond and to include emission reduction commitments for $PM_{2.5}$. In relation to Ireland, 2020 emission targets are 25 kt for SO_2 (65% below 2005 levels), 65 kt for NO_X (49% reduction), 43 kt for VOCs (25% reduction), 108 kt for NH_3 (1% reduction) and 10 kt for $PM_{2.5}$ (18% reduction).

European Commission Directive 2001/81/EC and the National Emissions Ceiling Directive (NECD), prescribes the same emission limits as the 1999 Gothenburg Protocol. A National EPA Programme for the progressive reduction of emissions of these four transboundary pollutants has been in place since April 2005. The data available from the EPA in 2021 indicated that Ireland complied with the emissions ceiling for SO_2 in recent years but failed to comply with the ceilings for NH_3, NO_X and NMVOCs. Directive (EU) 2016/2284 "On the Reduction of National Emissions of Certain Atmospheric Pollutants and Amending Directive 2003/35/EC and Repealing Directive 2001/81/EC" was published in December 2016. The Directive will apply the 2010 NECD limits until 2020 and establish new national emission reduction commitments which will be applicable from 2020 and 2030 for SO_2, NO_X, NMVOC, NH_3, $PM_{2.5}$ and CH_4. In relation to Ireland, 2020-29 emission targets are 25 kt for SO_2 (65% on 2005 levels), 65 kt for NO_X (49% reduction on 2005 levels), 43 kt for VOCs (25% reduction on 2005 levels), 108 kt for NH_3 (1% reduction on 2005 levels) and 10 kt for $PM_{2.5}$ (18% reduction on 2005 levels). In relation to 2030, Ireland's emission targets are 10.9 kt (85% below 2005 levels) for SO_2, 40.7 kt (69% reduction) for NO_X, 51.6 kt (32% reduction) for NMVOCs, 107.5 kt (5% reduction) for NH_3 and 11.2 kt (41% reduction) for $PM_{2.5}$.

13.2.2. Air Quality Guidelines

The principal guidance and best practice documents used to inform the assessment of potential impacts on Air Quality is summarised below.

In addition to specific air quality guidance documents, the following guidelines were considered and consulted in the preparation of this chapter:

- Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (hereafter referred to as the Environmental Protection Agency (EPA) Guidelines) (EPA, 2022a);
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (Department of Environment, Community and Local Government, August 2018); and
- Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment Report (European Commission 2017);

The assessment has made reference to national guidelines where available, in addition to international standards and guidelines relating to the assessment of air quality impacts. These are summarised below:

- Guidance on the Assessment of Dust from Demolition and Construction V1. (Institute of Air Quality Management (IAQM) (hereafter referred to as the IAQM Guidelines) (IAQM 2014);
- A Guide To The Assessment Of Air Quality Impacts On Designated Nature Conservation Sites (Version 1.1) (IAQM 2020); and
- PE-ENV-01106: Air Quality Assessment of Specified Infrastructure Projects (TII, 2022a).

13.2.3. Air Quality Assessment Methodology

13.2.3.1. Construction Phase

The Institute of Air Quality Management in the UK (IAQM) guidance document '*Guidance on the Assessment of Dust from Demolition and Construction*' (2014) outlines an assessment method for predicting the impact of dust emissions from demolition, earthworks, construction and haulage activities based on the scale and nature of the works and the sensitivity of the area to dust impacts. The IAQM methodology has been applied to the construction phase of this development in order to predict the likely risk of dust impacts in the absence of mitigation measures and to determine the level of site specific mitigation required. Transport Infrastructure Ireland (TII) recommends the use of the IAQM guidance (2014) in the TII guidance document *Air Quality Assessment of Specified Infrastructure Projects – PE-ENV-01106* (TII, 2022a).

The major dust generating activities are divided into four types within the IAQM guidance (2014) to reflect their different potential impacts. These are: -

Demolition.

Earthworks.

Construction.

Trackout (movement of heavy vehicles).

The magnitude of each of the four categories is divided into Large, Medium or Small scale depending on the nature of the activities involved. The magnitude of each activity is combined with the overall sensitivity of the area to determine the risk of dust impacts from site activities. This allows the level of site-specific mitigation to be determined.

Construction phase traffic also has the potential to impact air quality. The TII guidance *Air Quality Assessment of Specified Infrastructure Projects – PE-ENV-01106* (TII, 2022a), states that road links meeting one or more of the following criteria can be defined as being 'affected' by a Proposed Development and should be included in the local air quality assessment. While the guidance is specific to infrastructure projects the approach can be applied to any development that causes a change in traffic.

- Annual average daily traffic (AADT) changes by 1,000 or more;
- Heavy duty vehicle (HDV) AADT changes by 200 or more;
- Daily average speed change by 10 kph or more;
- Peak hour speed change by 20 kph or more;
- A change in road alignment by 5m or greater.

JB Barry Consultant Engineer have reviewed traffic data for the Proposed Development and in Chapter 5 (Section 5.4.8) of this EIAR, it has been determined by JB Barry Consultant Engineer that the construction stage traffic will not increase by 1,000 AADT, or 200 HDV AADT, the development will not result in speed changes or changes in public road alignment, therefore the traffic does not meet the above scoping criteria. Chapter 5 estimates that the Proposed Development would generate a maximum of 44 HGV movements per day during the peak construction period (11 days). As a result a detailed air quality assessment of construction stage traffic emissions has been scoped out from any further assessment as there is no potential for significant impacts to air quality.

13.2.3.2. Operational Phase

As there will be no change in operational phase traffic compared to the Permitted Development. Based on the TII scoping criteria detailed in Section 13.2.3.1 it was determined that a detailed air quality assessment of operational stage traffic emissions has been scoped out from any further assessment as there is no potential for significant impacts to air quality.

The assessment of baseline air quality in the region is conducted to review and ensure that the current levels of key pollutants are significantly lower than their limit values. The savings in NO_X emissions arising from the production of electricity using renewable sources were compared against those produced using non-renewable sources. The calculations were carried out using SEAI published emission rates from non-renewable energy sources (SEAI, 2022). This total NO_X saving annually and over the lifespan of the project relative to NO_X emissions from fossil fuel based power generation was established.

13.2.3.3. Air Quality Significance Criteria

The TII *Air Quality Assessment of Specified Infrastructure Projects – Overarching Technical Document PE-ENV-01106 (TII 2022a)* details the methodology for determining air quality impact significance criteria that are consistent with the Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA 2022a). The degree of impact is determined based on both the absolute and relative impact. The TII significance criteria have been adopted for the Proposed Development and are detailed in Table 13.2. The significance criteria are based on $PM_{2.5}$, PM_{10} and NO_2 as these pollutants are most likely to exceed the annual mean limit values (see Table 12.1).

Long term average Concentration at receptor in assessment year (µg/m³)	% Change in concentration relative to Air Quality Standard Value (AQLV)			
	1-2%	2-5%	5-10%	>10%
75% of less of AQLV	Neutral	Neutral	Slight	Moderate
76-94% of AQLV	Neutral	Slight	Moderate	Moderate
95-102% OF AQLV	Slight	Moderate	Moderate	Substantial
103-109% of AQLV	Moderate	Moderate	Substantial	Substantial
110% or more of AQLV	Moderate	Substantial	Substantial	Substantial

Source: Air Quality Assessment of Specified Infrastructure Projects – Overarching Technical Document (TII 2022a)

AQLV = Air Quality Limit Value

Table 13.2 Definition of Impact Descriptors for Changes in Ambient Pollutant Concentrations

13.2.4. Climate Standards and Policy

Ireland is party to both the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol (UNFCCC 2007). The Paris Agreement, which entered into force in 2016, is an important milestone in terms of international climate change agreements and includes an aim of limiting global temperature increases to no more than 2°C above pre-industrial levels with efforts to limit this rise to 1.5°C. The aim is to limit global GHG emissions to 40 gigatonnes as soon as possible whilst acknowledging that peaking of GHG emissions will take longer for developing countries. Contributions to GHG emissions will be based on Intended Nationally Determined Contributions (INDCs) which will form the foundation for climate action post 2020. Significant progress was also made in the Paris Agreement on elevating adaption onto the same level as action to cut and curb emissions. The Sharm el-Sheikh Implementation Plan was drafted at COP27 in November 2022. This plan included a new funding arrangement for "loss and damage" for vulnerable countries hit hard by climate disasters. No significant agreements were made regarding the phasing out of fossil fuels or limiting global heating to 1.5°C above pre-industrial levels, however the plan resolves to pursue further efforts to limit the rise to 1.5°.

In order to meet the commitments under the Paris Agreement, the EU enacted *Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No. 525/2013* (the Regulation). The Regulation aims to deliver, collectively by the EU in the most cost-effective manner possible, reductions in GHG emissions from the Emission Trading Scheme (ETS) and non-ETS sectors amounting to 43% and 30%, respectively, by 2030 compared to 2005 levels. Ireland's obligation under the Regulation is a 30% reduction in non-ETS greenhouse gas emissions by 2030 relative to its 2005 levels.

In 2015, the Climate Action and Low Carbon Development Act 2015 (No. 46 of 2015) (Government of Ireland, 2015) was enacted (the 2015 Act). The purpose of the 2015 Act was to enable Ireland '*to pursue, and achieve, the transition to a low carbon, climate resilient and environmentally sustainable economy by the end of the year 2050*' (section 3(1) of the 2015 Act). This is referred to in the 2015 Act as the '*national transition objective*'. The 2015 Act made provision for, *inter alia*, a national adaptation framework. In addition, the 2015 Act provided for the establishment of the Climate Change Advisory Council with the function to advise and make recommendations on the preparation of the national mitigation and adaptation plans and compliance with existing climate

obligations. The 2015 Act was amended by the Climate Action and Low Carbon Development (Amendment) Act 2021 (the 2015 Act as amended).

A duty imposed on planning authorities by section 15 of the Climate Action and Low Carbon Development Act 2015 (as amended) is:

"1) A relevant body [e.g., a planning authority] shall, in so far as practicable, perform its functions in a manner consistent with –

(a) the most recent approved climate action plan,

(b) the most recent approved national long term climate action strategy,

(c) the most recent approved national adaptation framework and approved sectoral adaptation plans,

(d) the furtherance of the national climate objective, and

(e) the objective of mitigating greenhouse gas emissions and adapting to the effects of climate change in the State."

The first Climate Action Plan (CAP) was published by the Irish Government in June 2019 (Government of Ireland, 2019a). The Climate Action Plan 2019 (2019 CAP) outlined the current status across key sectors including Electricity, Transport, Built Environment, Industry and Agriculture and outlined the various broadscale measures required for each sector to achieve ambitious decarbonisation targets. The 2019 CAP also detailed the required governance arrangements for implementation including carbon-proofing of policies, establishment of carbon budgets, a strengthened Climate Change Advisory Council and greater accountability to the Oireachtas. The Government published the second Climate Action Plan in November 2021 (Government of Ireland, 2021a). The plan contains similar elements as the 2019 CAP and aims to set out how Ireland can reduce our greenhouse gas emissions by 51% by 2030 (compared to 2018 levels) which is in line with the EU ambitions, and a longer-term goal of to achieving net-zero emissions no later than 2050.

Following on from Ireland declaring a climate and biodiversity emergency in May 2019 and the European Parliament approving a resolution declaring a climate and environment emergency in Europe in November 2019, the Government approved the publication of the General Scheme for the Climate Action (Amendment) Bill 2019 in December 2019 (Government of Ireland 2019b) followed by the publication of the Climate Action and Low Carbon Development (Amendment) Act 2021 (No. 32 of 2021) (hereafter referred to as the 2021 Climate Act) in July 2021 (Government of Ireland, 2021b). The 2021 Climate Act was prepared for the purposes of giving statutory effect to the core objectives stated within the CAP.

The purpose of the 2021 Climate Act is to provide for the approval of plans '*for the purpose of pursuing the transition to a climate resilient, biodiversity rich and climate neutral economy by no later than the end of the year 2050*'. The 2021 Climate Act will also '*provide for carbon budgets and a decarbonisation target range for certain sectors of the economy*'. The 2021 Climate Act defines the carbon budget as '*the total amount of greenhouse gas emissions that are permitted during the budget period*'. The 2021 Climate Act removes any reference to a national mitigation plan and instead refers to both the Climate Action Plan, as published in 2019, and a series of National Long Term Climate Action Strategies. In addition, the Environment Minister shall request each local authority to make a '*local authority climate action plan*' lasting five years and to specify the mitigation measures and the adaptation measures to be adopted by the local authority.

In relation to carbon budgets, the 2021 Climate Action and Low Carbon Development (Amendment) Act states '*A carbon budget, consistent with furthering the achievement of the national climate objective, shall be proposed by the Climate Change Advisory Council, finalised by the Minister and approved by the Government for the period of 5 years commencing on the 1 January 2021 and ending on 31 December 2025 and for each subsequent period of 5 years (in this Act referred to as a 'budget period')*'. The carbon budget is to be produced for 3 sequential budget periods, as shown in Table 13.3. The carbon budget can be revised where new obligations are imposed under the law of the European Union or international agreements or where there are significant developments in scientific knowledge in relation to climate change. In relation to the sectoral emissions ceiling, the Minister for the Environment, Climate and Communications (the Minister for the Environment) shall prepare and submit to government the maximum amount of GHG emissions that are permitted in different sectors of the economy during a budget period and different ceilings may apply to different sectors. The sectorial emission ceilings for 2030 were published in July 2022 and are shown in Table 13.4. Electricity has a 75% reduction requirement by 2030 compared to 2018 levels.

In December 2022, CAP23 was published (Government of Ireland, 2022). This is the first CAP since the publication of the carbon budgets and sectoral emissions ceilings, and it aims to implement the required changes to achieve a 51% reduction in carbon emissions by 2030. The CAP has six vital high impact sectors where the biggest savings can be made: renewable energy, energy efficiency of buildings, transport, sustainable farming, sustainable business and change of land-use. CAP23 states that the decarbonisation of Irelands manufacturing industry is key for Ireland's economy and future competitiveness.

CAP23 aims to bring 9 GW onshore wind, 8 GW solar, at least 7 GW of offshore wind and 2 GW green hydrogen into Irish energy production by 2030. In addition, the CAP aims to increase micro-generation and small-scale generation of renewables. CAP23 aims to phase out and end the use of coal and peat in electricity generation by 2030.

There is a target to reduce the embodied carbon in construction materials by 10% for materials produced and used in Ireland by 2025 and by at least 30% for materials produced and used in Ireland by 2030. CAP23 states that these reductions can be brought about by product substitution for construction materials and reduction of clinker content in cement. Cement and other high embodied carbon construction elements can be reduced by the adoption of the methods set out in the Construction Industry Federation 2021 report Modern Methods of Construction. In order to ensure economic growth can continue alongside a reduction in emissions, the IDA Ireland will also seek to attract businesses to invest in decarbonisation technologies.

In April 2023 the Government published a draft Long-term Strategy on Greenhouse Gas Emissions (Government of Ireland, 2023), which provides a long-term plan on how Ireland will transition towards net carbon zero by 2050, achieving the interim targets set out in the CAP. The strategy will be updated on the basis of a second round of public consultation throughout 2023 and published after this is complete.

Sector	Reduction Required	2018 Emissions ($MtCO_2e$)
2021-2025	295 Mt CO_2eq	Reduction in emissions of 4.8% per annum for the first budget period.
2026-2030	200 Mt CO_2eq	Reduction in emissions of 8.3% per annum for the second budget period.
2031-2035	151 Mt CO_2eq	Reduction in emissions of 3.5% per annum for the third provisional budget.

Table 13.3 5-Year Carbon Budgets 2021-2025, 2026-2030 and 2031-2025

Sector	Reduction Required	2018 Emissions ($MtCO_2e$)	2030 Emission Ceiling ($MtCO_2e$)
Electricity	75%	10.5	3
Transport	50%	12	6
Buildings (Commercial and Public)	45%	2	1
Buildings (Residential)	40%	7	4
Industry	35%	7	4
Agriculture	25%	23	17.25
Other (F-Gases, Waste & Petroleum refining)	50%	2	1

Table 13.4 Sectoral Emission Ceilings 2030

13.2.5. Climate Guidelines

The principal guidance and best practice documents used to inform the assessment of potential impacts on climate is summarised below.

Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (hereafter referred to as the Environmental Protection Agency (EPA) Guidelines) (EPA, 2022a);

Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (Department of Environment, Community and Local Government, August 2018); and

Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment Report (European Commission 2017);

The assessment has made reference to national guidelines where available, in addition to international standards and guidelines relating to the assessment of climate impacts. These are summarised below:

PE-ENV-01104: Climate Guidance for National Roads, Light Rail and Rural Cycleways (offline & Greenways) – Overarching Technical Document (TII 2022d),

PE-ENV-01105: Climate Assessment of Proposed National Roads – Standard (TII 2022e);

GE-ENV-01106: TII Carbon Assessment Tool for Road and Light Rail Projects and User Guidance Document (TII 2022f);

Assessing Greenhouse Gas Emissions and Evaluating their Significance (IEMA, 2022)

Technical guidance on the climate proofing of infrastructure in the period 2021-2027 (European Commission 2021a)

Scottish Carbon Calculator Tool (Scottish Government 2023).

13.2.6. Climate Assessment Methodology

As per PE-ENV-01104 (TII 2022d) the climate assessment is broken into two main headings:

Greenhouse Gas Emissions Assessment (GHGA) – Quantifies the GHG emissions from a project over its lifetime. The assessment compares these emissions to relevant carbon budgets, targets and policy to contextualise magnitude.

Climate Change Risk assessment (CCRA) – Identifies the impact of a changing climate on a project and receiving environment. The assessment considers a project's vulnerability to climate change and identifies adaptation measures to increase project resilience.

13.2.6.1. Construction Phase

Climate change is a result of increased levels of carbon dioxide and other GHGs in the atmosphere causing the heat trapping potential of the atmosphere to increase. GHGs can be emitted from vehicles and embodied energy associated with materials used in the construction of a development. Embodied energy refers to the sum of the energy needed to produce a good or service. It incorporates the energy needed in the mining or processing of raw materials, the manufacturing of products and the delivery of these products to site. There is the potential for a number of embodied GHGs and GHG emissions during the construction phase of the development. Construction vehicles, generators etc., may give rise to CO_2 and N_2O emissions as well as the large quantities of material such as stone, concrete and steel that will be required for a project of this magnitude. The Institute of Air Quality Management document *Guidance on the Assessment of Dust from Demolition and Construction* (IAQM, 2014) states that site traffic and plant is unlikely to make a significant impact on climate. However, due to the nature of this project, climate impacts including the embodied energy from construction materials and site vehicles have been assessed.

The Institute of Environmental Management and Assessment (IEMA) guidance note on *"Assessing Greenhouse Gas Emissions and Evaluating their Significance"* (IEMA, 2022) states that the crux of significance regarding impact on climate is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050. A project that causes GHG emissions to be avoided or removed from the atmosphere has a beneficial effect that is significant. Only projects that actively reverse (rather than only reduce) the risk of severe climate change can be judged as having a beneficial effect. Where the fundamental reason for a proposed project is to combat climate change (e.g. a wind farm or carbon capture and storage project) and this beneficial effect drives the project need, then it is likely to be significant.

The GHG assessment commences with the high-level design, through the pre-construction (site clearance) stage, followed by the assessment of the embodied carbon associated with all materials used in the construction of the proposed development, the emissions during the construction phase activities and additionally emissions related to waste generated during the construction phase. As part of the proposed development, Construction Phase embodied GHG emissions are categorised under the following headings:

Land clearance activities (i.e. peat movement, tree felling);

Transport of excavated material within the site;

Manufacture of materials and transport to site;

Construction works; and

Construction waste products (including transport off-site).

Detailed information for the Proposed Development, including volumes of materials, were obtained from the Project Team. All peat and spoil material will remain within the site boundary.

As part of the Proposed Development, a quantity of peat will be excavated. As discussed in the *Best Practice Guidelines for the Irish Wind Energy Industry* (IWEA, 2012), excavation of peat can be a contributor to carbon losses associated with wind farm construction. The guidance states "*it is good practice to undertake a calculation of the carbon costs of the* construction *and operation of a wind farm. The carbon release associated with the excavation and oxidization of peat soils can be relatively significant and should be included in any carbon calculation"* (IWEA, 2012). The Scottish Carbon Calculator Tool was used to calculate carbon emissions and carbon savings as a result of the proposed wind farm - www.gov.scot. Input data used in the calculations is presented in Appendix 12.1.

In addition to assessing the impacts of the Proposed Development, as defined in chapter 1 and 2, on climate change in the form of a Greenhouse Gas Assessment (GHGA), the impact of climate change on the Proposed Development must be considered. This is completed by a climate change risk assessment (CCRA). A CCRA considers a project's vulnerability to climate change and identifies adaptation measures.

The climate vulnerability and risk assessment helps identify the significant climate risks. It is the basis for identifying, appraising and implementing targeted adaptation measures. This will help reduce the residual risk to an acceptable level.

13.2.6.2. Operational Phase

Greenhouse Gas Assessment (GHGA)

During the operational phase there will be no likely significant negative GHG emissions from the operation of the Proposed Development.

Operational phase traffic has the potential to generate GHG emissions as a result of increased vehicle movements associated with the proposed development. During the operational phase, the only traffic associated with the Proposed Development will be trips due to maintenance staff which are not considered significant. During normal operation these are likely to be one to two trips weekly. There is no change in traffic volumes from the Permitted Development.

The savings in CO_2 emissions arising from the production of additional electricity using renewable sources were compared against those produced using non-renewable sources. The calculations were carried out using SEAI published emission rates from non-renewable energy sources (SEAI, 2022). This total CO_2 saving annually and over the lifespan of the Project relative to CO_2 emissions from fossil fuel power generation was established.

Climate Change Risk Assessment (CCRA)

PE-ENV-01104 (TII 2022d) states that the CCRA is guided by the principles set out in the overarching best practice guidance documents:

- EU (2021) Technical guidance on the climate proofing of Infrastructure in the Period 2021-2027 (European Commission, 2021); and
- The Institute of Environmental Management and Assessment, Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation (2nd Edition) (IEMA, 2020).

The baseline environment information provided in Section 13.3.2, future climate change modelling and input from other experts working on the Proposed Development (e.g. hydrologists) should be used in order to assess the likelihood of a climate hazard.

The initial stage of an assessment is to establish a scope and boundary for the assessment taking into account the following criteria:

- Spatial boundary: As per PE-ENV-01104 (TII 2022d), the study area with respect to the GHGA is Ireland's Climate budget. The study area with respect to the CCRA can be considered the project boundary and its assets that are considered within the methodology. The study area will be influenced by current and future baselines (Section 13.3.2). This study area is influenced by the input of other experts within the EIAR team;
- Climate hazards: The outcomes of the climate screening i.e. vulnerability assessment and baseline assessment; and
- Project receptors: TII state that the project receptors are the asset categories considered in the climate screening. In addition, any critical connecting infrastructure and significant parts of the surrounding environment e.g. water bodies that should be considered as a part of the indirect, cumulative and in combination impact assessment should also be considered project receptors (i.e. the turbines, access roads).

Technical guidance on the climate proofing of infrastructure in the period 2021-2027 (European Commission 2021a) outlines an approach for undertaking a climate change risk assessment where there is a potentially significant impact on the Proposed Development due to climate change. The risk assessment assesses the likelihood and consequence of the impact occurring, leading to the evaluation of the significance of the impact. The role of the climate consultant in assessing the likelihood and impact is often to facilitate the climate change risk assessment process with input from the design team or specific specialists such as hydrology.

Examples of climate hazards which are considered in the risk assessment include:

- Flooding (coastal) – including sea level rise and storm surge.
- Flooding (pluvial);
- Flooding (fluvial);
- Extreme heat – including extreme heat events and increasing temperatures overtime;
- Extreme cold – including frost and snow;
- Wildfire;
- Drought;
- Extreme wind;
- Lightning and hail;
- Landslides; and
- Fog.

The climate screening risk assessment comprises of a sensitivity analysis which is intended to evaluate the project's vulnerability to climate change. This is completed by combining a sensitivity (Table 13.5) and exposure (Table 13.6) analysis. The sensitivity analysis identifies the climate hazards relevant to the specific project type irrespective of its location (example: Sea level rise will affect seaport projects regardless of location). Sensitivity ratings are classed as:

- High Sensitivity: the climate hazard may have a significant impact on assets and processes, inputs, outputs and transport links. This is a sensitivity score of 3;
- Medium Sensitivity: the climate hazard may have a slight impact on assets and processes, inputs, outputs and transport links. This is a sensitivity score of 2; and
- Low Sensitivity: the climate hazard has no (or insignificant) impact. This is a sensitivity score of 1.

The European Commission assessment states that there are four themes to sensitivity analysis. Transport links may be outside the direct control of the project but still should be considered. TII (TII 2022a) set out the following as potential sensitive receptors: drainage, structures, earthworks, geotechnical, utilities, landscaping, turbines, or access roads.

Sensitive Receptors	Sensitivity to Climate Hazards (No consideration of site location)								
	Flood (Fluvial/Pluvial)	Extreme Heat	Extreme Cold	Drought	Wind	Wildfire	Fog	Lightning & Hail	Landslides
Drainage									
Structures / Turbines									
Earthworks									
Utilities									
Landscaping									
Access Roads									

Table 13.5 Screening Assessment: Sensitivity Categories

The exposure analysis identifies the climate hazards relevant to the planned project location irrespective of the project type for example: flooding could be a risk if the project location is next to a river in a floodplain. Exposure may be classed as high, medium or low:

- High exposure: It is almost certain or likely this climate hazard will occur at the project location i.e. might arise once to several times per year. This is an exposure score of 3;
- Medium exposure: It is possible this climate hazard will occur at the project location i.e. might arise a number of times in a decade. This is an exposure score of 2; and
- Low exposure: It is unlikely or rare this climate hazard will occur at the project location i.e. might arise a number of times in a generation or in a lifetime. This is an exposure score of 1.

Climate Exposure	Exposure Risk to Climate Variable (Consider the site location)								
	Flood pluvial	Extreme Heat	Extreme Cold	Drought	Wind	Wildfire	Fog	Lightning & Hail	Landslides
Without exposure at project location									

Table 13.6 Screening Assessment: Exposure Assessment

Once sensitivity and exposure are categorised, a vulnerability analysis is conducted using Table 13.7 . If the project scores a high or medium vulnerability, the project should proceed to add further mitigation measures including management for vulnerabilities that cannot be fully mitigated.

		Exposure (current + future climate)		
		High	Medium	Low
Sensitivity (highest across the four themes)	High	High	High	Medium
	Medium	High	Medium	Low
	Low	Medium	Low	Low

Table 13.7 Screening Assessment: Vulnerability Analysis

13.2.6.3. Climate Significance Criteria

Significance Criteria for GHGA

PE-ENV-01104 (TII 2022d) outlines a recommended approach for determining the significance of both the Construction and Operational Phases. The approach is based on comparing the '*Do Something*' scenario and the net project GHG emissions (i.e. *Do Something – Do Minimum*) to the relevant carbon budgets (Department of the Taoiseach 2022). With the publication of the Climate Action Act in 2021, sectoral carbon budgets have been published for comparison with the Net CO_2 project GHG emissions from the proposed development. The electricity sector emitted approximately 10.5 $MtCO_{2eq}$ in 2018 and has a ceiling of 3 $MtCO_{2eq}$ in 2030 which is a 75% reduction over this period.

PE-ENV-01104 (TII 2022d) state that significance of GHG effects is based on IEMA guidance (IEMA 2022) which is consistent with the terminology contained within Figure 3.4 of the EPA's (2022) 'Guidelines on the information to be contained in Environmental Impact Assessment Reports'.

The 2022 Guidance (IEMA 2022), a guidance which PE-ENV-01104 (TII 2022d) takes a lead from, sets out the following principles for significance:

- When evaluating significance, all new GHG emissions contribute to a negative environmental impact; however, some projects will replace existing development or baseline activity that has a higher GHG profile. The significance of a project's emissions should therefore be based on its net impact over its lifetime, which may be positive, negative or negligible;
- Where GHG emissions cannot be avoided, the goal of the EIA process should be to reduce the project's residual emissions at all stages; and

- Where GHG emissions remain significant, but cannot be further reduced, approaches to compensate the project's remaining emissions should be considered.

TII (TII 2022d) states that professional judgement must be taken into account when contextualising and assessing the significance of a project's GHG impact. In line with IEMA Guidance (IEMA, 2022), TII state that the crux of assessing significance is "*not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050*".

Significance is determined using Table 13.8 (derived from Table 6.7 of PE-ENV-01104 (TII 2022d)) along with a with consideration of the following two factors:

- The extent to which the trajectory of GHG emissions from the project aligns with Ireland's GHG trajectory to net zero by 2050; and
- The level of mitigation taking place.

Effects	Significance level Description	Description
Significant adverse	Major adverse	The project's GHG impacts are not mitigated.
		The project has not complied with do-minimum standards set through regulation, nor provide reductions required by local or national policies; and
		No meaningful absolute contribution to Ireland's trajectory towards net zero.
	Moderate adverse	The project's GHG impacts are partially mitigated.
		The project has partially complied with do-minimum standards set through regulation, and have not fully complied with local or national policies; and
		Falls short of full contribution to Ireland's trajectory towards net zero.
Not significant	Minor adverse	The project's GHG impacts are mitigated through 'good practice' measures.
		The project has complied with existing and emerging policy requirements; and
		Fully in line to achieve Ireland's trajectory towards net zero.
	Negligible	The project's GHG impacts are mitigated beyond design standards.
		The project has gone well beyond existing and emerging policy requirements; and
		Well 'ahead of the curve' for Ireland's trajectory towards net zero.
Beneficial	Beneficial	The project's net GHG impacts are below zero and it causes a reduction in atmosphere GHG concentration.
		The project has gone well beyond existing and emerging policy requirements; and
		Well 'ahead of the curve' for Ireland's trajectory towards net zero, provides a positive climate impact.

Table 13.8 GHGA Significance Matrix

Significance Criteria for CCRA

The significance rating for the CCRA in Table 13.9 is provided on the basis that all adaptation/mitigation measures have been implemented. Any risks that remain significant (i.e. a high or extreme risk) should be prioritised in the monitoring and reviews to the risk assessment.

Risk Rating	Number of Risks	
	Initial risk rating	Residual risk rating
Low Risk	No. of low risk	No. of low risk
Medium Risk	No. of medium risk	No. of medium risk
High Risk	No. of high risk	No. of high risk
Extreme Risk	No. of extreme risk	No. of extreme risk

Table 13.9 Significance Criteria for CCRA

13.3. Baseline Conditions

13.3.1. Air Quality Baseline

13.3.1.1. Air Quality Receptors

In line with the UK Institute of Air Quality Management (IAQM) guidance document '*Guidance on the Assessment of Dust from Demolition and Construction*' (2014) prior to assessing the impact of dust from a Proposed Development the sensitivity of the area must first be assessed as outlined below. Both receptor sensitivity and proximity to proposed works areas are taken into consideration. For the purposes of this assessment, high sensitivity receptors are regarded as residential properties where people are likely to spend the majority of their time. Commercial properties and places of work are regarded as medium sensitivity while low sensitivity receptors are areas where people are present for short periods or where the public would not expect a high level of amenity.

In terms of receptor sensitivity to dust soiling, there are no residential properties within 500 m of where vehicle access crosses into the site boundary therefore receptors are unlikely to be significantly impacted. It is recognised that the HGV deliveries during the construction phase will pass residential properties as per the identified delivery route. Figure 13.1 shows the location of the site and sensitive receptors. The closest residential receptor is approximately 1km from the site. Therefore, the overall sensitivity of the area to dust soiling impacts is considered low based on the IAQM criteria outlined in Table 13.10.

Receptor Sensitivity	Number Of Receptors	Distance from source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table 13.10 Sensitivity of the Area to Dust Soiling Effects on People and Property

In addition to sensitivity to dust soiling, the IAQM guidelines also outline the assessment criteria for determining the sensitivity of the area to human health impacts. The criteria take into consideration the current annual mean PM_{10} concentration, receptor sensitivity based on type (residential receptors are classified as high sensitivity) and the number of receptors affected within various distance bands from the construction works. A conservative estimate of the current annual mean PM_{10} concentration in the vicinity of the Proposed Development is 13 µg/m^3 (see Section 13.3.1.3) and there are no properties within 350m of the Proposed Development boundary (see Figure 13.1). Based on the IAQM criteria outlined in Table 13.11, the worst-case sensitivity of the area to dust related human health impacts is considered low.

Receptor Sensitivity	Annual Mean PM_{10} Concentration	Number Of Receptors	Distance from source (m)				
			<20	<50	<100	<200	<350
High	< 24 µg/m^3	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	< 24 µg/m^3	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	< 24 µg/m^3	>1	Low	Low	Low	Low	**Low**

Table 13.11 Sensitivity of the Area to Dust Related Human Health Impacts

The IAQM guidelines also outline the assessment criteria for determining the sensitivity of the area to dust-related ecological impacts. Dust emissions can coat vegetation leading to a reduction in the photosynthesising ability of the plant as well as other effects. The guidance states that dust impacts to vegetation can occur up to 50 m from the site and 50 m from site access roads, up to 500m for the site entrance. Sensitive ecology has the potential to be impacted by the construction phase of the development and therefore should be considered. The Connemara Bog Complex Special Area of Conservation (SAC) and pNHA (Site code: 002034) are designated ecology areas in the vicinity of the proposed site but are further than the 50m from the site boundary. 50m is the area of potential impact as per IAQM Guidance (IAQM 2014) for sensitive ecology and therefore the Connemara Bog Complex Special Area of Conservation (SAC) and pNHA is unlikely to be significantly impacted. Therefore as there is no designated ecological sites within 50 m of the site or, 500 m of where vehicle access crosses into the site boundary, there is no potential for impacts.

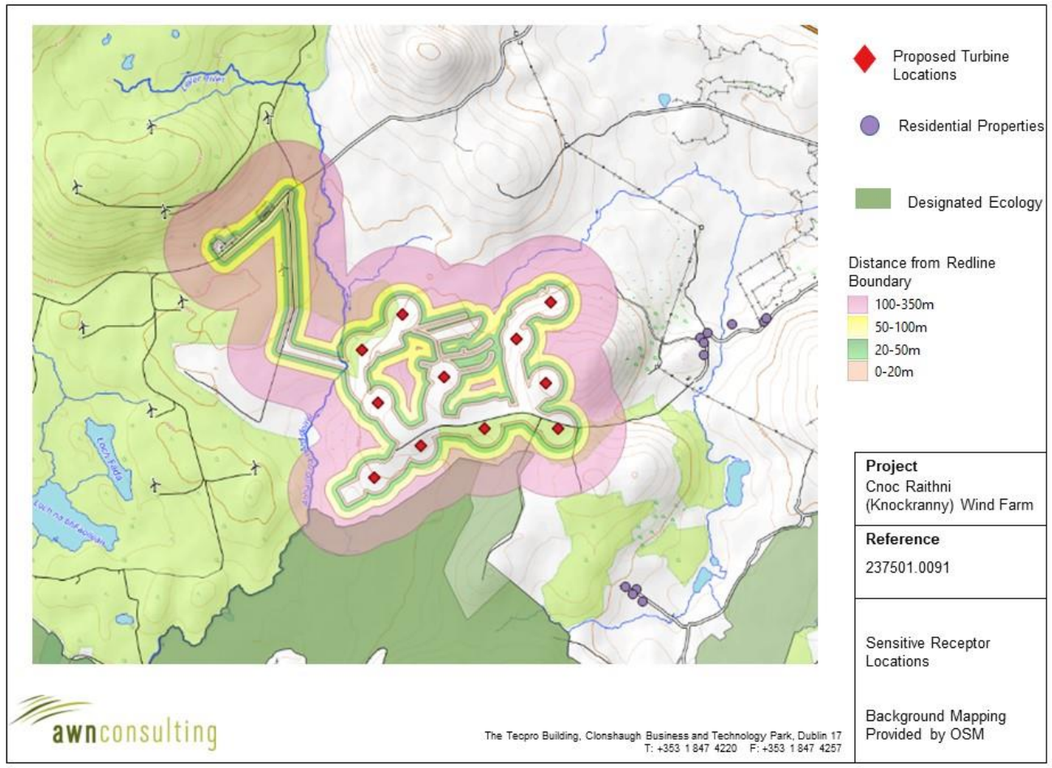

Figure 13.1 Figure 13.1 – Receptor Locations

13.3.1.2. Meteorological Data

A key factor in assessing temporal and spatial variations in air quality are the prevailing meteorological conditions. Depending on wind speed and direction, individual receptors may experience very significant variations in pollutant levels under the same source strength (i.e. traffic levels) (WHO, 2006). Wind is of key importance in dispersing air pollutants and, for ground level sources such as traffic emissions, pollutant concentrations are generally inversely related to wind speed. Thus, concentrations of pollutants derived from traffic sources will generally be greatest under very calm conditions and low wind speeds when the movement of air is restricted. In relation to PM_{10}, the situation is more complex due to the range of sources of this pollutant. Smaller particles (less than $PM_{2.5}$) from traffic sources will be dispersed more rapidly at higher wind speeds. However, fugitive emissions of coarse particles ($PM_{2.5}$ – PM_{10}) will actually increase at higher wind speeds. Thus, measured levels of PM_{10} will be a non-linear function of wind speed.

The nearest representative weather station collating detailed weather records is Claremorris meteorological station. The monitoring station is located approximately 43km north, north-east of the site. Claremorris meteorological station data has been examined to identify the prevailing wind direction and average wind speeds. Wind frequency is important as dust can only be dispersed by winds, and deposition of dust is a simple function of particle size, wind speed and distance.

Dust emissions are dramatically reduced where rainfall has occurred due to the cohesion created between dust particles and water and the removal of suspended dust from the air. It is typical to assume no dust is generated under "wet day" conditions where rainfall greater than 0.2 mm has fallen. Information collected from Shannon Airport meteorological station (30- year average data is not available from Claremorris and therefore a suitable alternative was reviewed), identified that typically 211 days per annum are "wet" (Met Eireann 2023, 30-year averages). Thus, almost 57% of the time no significant dust generation will be likely due to meteorological conditions.

13.3.1.3. Review of EPA Air Monitoring Data

Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities. The most recent EPA published annual report on air quality "*Air Quality In Ireland 2021*" (EPA 202b2) details the range and scope of monitoring undertaken throughout Ireland.

As part of the implementation of the Framework Directive on Air Quality (1996/62/EC), four air quality zones have been defined in Ireland for air quality management and assessment purposes as outlined within the EPA document titled 'Air Quality In Ireland 2021' (EPA 2022c). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000 is defined as Zone D. In terms of air monitoring, the area of the Proposed Development is categorised as Zone D.

In 2020 the EPA reported (EPA 2022c) that Ireland was compliant with EU legal air quality limits at all locations, however this was largely due to the reduction in traffic due to Covid-19 restrictions. The EPA *Air* Quality *in Ireland 2020* report details the effect that the Covid-19 restrictions had on air monitoring stations, which included reductions of up to 50% at some monitoring stations which have traffic as a dominant source. For this reason, data from 2020 have been included in the baseline section for representative purposes only and previous long-term data has been used to determine baseline levels of pollutants in the vicinity of the proposed development.

Long-term NO_2 monitoring was carried out at the Zone D locations of Castlebar, Emo and Kilkitt for the period 2017 - 2021 (EPA 2022c). Long term average concentrations are significantly below the annual average limit of 40 $\mu g/m^3$; average results range from 4 – 7 $\mu g/m^3$ (Table 13.12) over the five-year period, with a maximum monitored annual mean concentration of 8 $\mu g/m^3$. Based on the above information an estimate of the current background NO_2 concentration for the region of the Proposed Development is 8 $\mu g/m^3$.

Station	Averaging Period Notes 1,	Year				
		2017	2018	2019	2020	2021
Castlebar	Annual Mean NO_2 (µg/m^3)	7	8	8	6	6
	99.8th %ile 1-hr NO_2 (µg/m^3)	60	60	59	54	48
Kilkitt	Annual Mean NO_2 (µg/m^3)	2	3	5	2	2
	99.8th %ile 1-hr NO_2 (µg/m^3)	17	22	42	13	11
Emo	Annual Mean NO_2 (µg/m^3))	3	3	4	4	4
	99.8th %ile 1-hr NO_2 (µg/m^3)	28	42	28	23	28

Note 1 Annual average limit value of 40 µg/m^3 and hourly limit value of 200 µg/m^3 (EU Council Directive 2008/50/EC & S.I. No. 739 of 2022).

Table 13.12 Trends in Zone D Air Quality – NO_2

Continuous PM_{10} monitoring was carried out at the Zone D locations of Castlebar, Claremorris and Kilkitt for 2017 - 2021. Levels range from 8 – 12 µg/m^3 over the five-year period (Table 13.13). In addition the 24-hour limit value of 50 µg/m^3 (as a 90.4th percentile) was complied with at all sites (EPA, 2022c). Based on the EPA data, an estimate of the current background PM_{10} concentration in the region of the Proposed Development is 13 µg/m^3.

Station	Averaging Period Notes 1,	Year				
		2017	2018	2019	2020	2021
Castlebar	Annual Mean PM_{10} (µg/m^3)	11	11	16	14	10
	90th %ile 24-hr PM_{10} (µg/m^3)	19	20	24	22	22
Kilkitt	Annual Mean PM_{10} (µg/m^3)	8	9	7	8	8
	90th %ile 24-hr PM_{10} (µg/m^3)	14	15	13	14	13
Emo	Annual Mean PM_{10} (µg/m^3)	11	12	11	10	10
	90th %ile 24-hr PM_{10} (µg/m^3)	17	20	20	16	13

Note 1 Annual average limit value of 40 µg/m^3 and 24-hour limit value of 50 µg/m^3 (EU Council Directive 2008/50/EC & S.I. No. 739 of 2022).

Table 13.13 Trends in Zone D Air Quality – PM_{10}

Monitoring of both PM_{10} and $PM_{2.5}$ takes place at the station in Claremorris which allows for the $PM_{2.5}/PM_{10}$ ratio to be calculated. Average $PM_{2.5}$ levels in Claremorris over the period 2017 - 2021 ranged from 4 - 8 µg/m^3, with a $PM_{2.5}/PM_{10}$ ratio ranging from 0.36 – 0.86 (EPA 2022c). Based on this information, a ratio of 0.7 was used to generate an existing $PM_{2.5}$ concentration in the region of the development of 9.1 µg/m^3.

NO_x monitoring (EPA 2022c) was conducted in the rural background stations of Emo and Kilkitt for the period 2015 - 2019 (EPA, 2022b). Long term average concentrations are significantly below the annual average limit of 30 µg/m^3; average results range from 2.5 – 7.6 µg/m^3. Based on the above information an estimate of the current background NO_x concentration for the region of the Proposed Development is 8 µg/m^3.

13.3.2. Climate Baseline

PE-ENV-01104 (TII 2022d) states that a baseline climate scenario should identify, consistent with the study area for the project, GHG emissions without the project for both the current and future baseline (Do-Minimum scenarios).

Ireland declared a climate and biodiversity emergency in May 2019 and in November 2019 there was European Parliament approval of a resolution declaring a climate and environment emergency in Europe. This, in addition to Ireland's current failure to meet its EU binding targets under Regulation 2018/842 (European Union 2018) results in changes in GHG emissions either beneficial or adverse being of more significance than previously considered prior to these declarations.

Data published in 2022 (EPA 2022d) predicts that Ireland exceeded (without the use of flexibilities) its 2021 annual limit set under EU's Effort Sharing Decision (ESD) (EU 2018/842) by 2.71million tonnes CO_2 equivalent (Mt CO_{2eq})

as shown in Table 13.14. The sector with the highest emissions in 2021 is agriculture at 38% of the total, followed by transport at 17.7%. For 2021 (EPA 2022d), total national emissions were estimated to be 62.110 Mt CO_{2eq} as shown in Table 13.14. Energy Industries accounted for 16.5% of Ireland's 2021 emissions.

The future baseline with respect to the GHGA can be considered the future targets which the significance criteria will be compared against. In line with TII (TII 2022d) and IEMA Guidance (IEMA, 2022) the future baseline is a trajectory towards net zero by 2050 "*whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050*".

The future baseline will be determined by Ireland meeting its targets set out in the CAP23, and future CAPs, alongside binding 2030 EU targets. In order to meet the commitments under the Paris Agreement, the European Union (EU) enacted 'Regulation (EU) 2018/842 on binding annual GHG emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No. 525/2013' (hereafter referred to as the Regulation) (European Union 2018). The Regulation aims to deliver, collectively by the EU in the most cost-effective manner possible, reductions in GHG emissions from the Emission Trading Scheme (ETS) and non-ETS sectors amounting to 43% and 30%, respectively, by 2030 compared to 2005. The ETS is an EU-wide scheme which regulates the GHG emissions of larger industrial emitters including electricity generation, cement manufacturing and heavy industry. The non-ETS sector includes all domestic GHG emitters which do not fall under the ETS scheme and thus includes GHG emissions from transport, residential and commercial buildings and agriculture.

Category	2021 Kilotonnes CO_{2eq}	% of Total GHG emissions
Waste	943	1.5%
Energy Industries	10,272	16.5%
Residential	6,917	11.1%
Manufacturing Combustion	4,624	7.4%
Commercial Services	836	1.3%
Public Services	659	1.1%
Transport	10,989	17.7%
Industrial Processes	2,477	4.0%
F-gases	766	1.2%
Agriculture	23,626	38.0%
Total	62,110	100.00%

Table 13.14 Total National GHG Emissions In 2021

Impacts as a result of climate change will evolve with a changing future baseline, changes have the potential to include increases in global temperatures and increases in the number of rainfall days per year. Therefore, it is expected that the baseline climate will evolve over time and consideration is needed with respect to this within the detailed design of the Proposed Development as per the European Commission Technical guidance on the climate proofing of infrastructure in the period 2021-2027 (European Commission 2021) and PE-ENV-01104 (TII 2022d) should the Proposed Development proceed.

Ireland has seen increases in the annual rainfall in the north and west of the country, with small increases or decreases in the south and east (EPA 2021). The EPA have compiled a list of potential adverse impacts (EPA 2021) as a result of climate change including the following which may be of relevance to the proposed development:

- More intense storms and rainfall events;
- Increased likelihood and magnitude of river and coastal flooding;
- Water shortages in summer in the east;
- Adverse impacts on water quality; and
- Changes in distribution of plant and animal species.

EPA's State of the Irish Environment Report (Chapter 2: Climate Change) (EPA 2020a) notes that projections show that full implementation of additional policies and measures, outlined in the 2019 Climate Action Plan, will result in a reduction in Ireland's total GHG emissions by up to 25 per cent by 2030 compared with 2020 levels. Climate change is not only a future issue in Ireland, as a warming of approximately 0.8°C since 1900 has already occurred. The EPA state that it is critically important for the public sector to show leadership and decarbonise all public transport across bus and rail networks to the lowest carbon alternatives. The report (EPA 2020a) underlines that the next decade needs to be one of major developments and advances in relation to Ireland's response to climate change in order to achieve these targets and that Ireland must accelerate the rate at which it implements GHG emission reductions. The report states that mid-century mean annual temperatures in Ireland are projected to increase by between 1.0°C and 1.6°C (subject to the emissions trajectory). In addition, heat events are expected to increase by mid-century (EPA 2020a). While individual storms are predicted to have more severe winds, the average wind speed has the potential to decrease (EPA 2020a).

TII's Guidance document PE-ENV-01104 (TII 2022d) states that for future climate change a moderate to high Representative Concentration Pathways (RCP) should be adopted. RPC4.5 is considered moderate while RPC8.5 is considered high. Representative Concentration Pathways (RCPs) describe different 21st century pathways of GHG emissions depending on the level of climate mitigation action undertaken.

Future climate predictions undertaken by the EPA have been published in 'Research 339: High-resolution Climate Projections for Ireland – A Multi-model Ensemble Approach (EPA 2020b). The future climate was simulated under both Representative Concentration Pathway 4.5 (RCP4.5) (medium-low) and RCP8.5 (high) scenarios. This study indicates that by the middle of this century (2041–2060). Mid-century mean annual temperatures are projected to increase by 1 to 1.2°C and 1.3 to 1.6°C for the RCP4.5 and RCP8.5 scenarios, respectively, with the largest increases in the east. Warming will be enhanced at the extremes (i.e. hot days and cold nights), with summer daytime and winter night-time temperatures projected to increase by 1 to 2.4°C. There will be a substantial decrease of approximately 50% which is projected for the number of frost and ice days. Summer heatwave events are expected to occur more frequently, with the largest increases in the south. In addition, precipitation is expected to become more variable, with substantial projected increases in the occurrence of both dry periods and heavy precipitation events. Climate change also has the potential to impact future energy supply which will rely on renewables such as wind and hydroelectric. Wind turbines need a specific range of wind speeds to operate within and droughts or low ground water levels may impact hydroelectric energy generating sites. More frequent storms have the potential to damage the communication networks requiring additional investment to create resilience within the network.

The EPA's Critical Infrastructure Vulnerability to Climate Change report (EPA 2021) assesses the future performance of Irelands critical infrastructure when climate is considered. Wind farms are considered to be vulnerable to a medium risk of wind related impacts, with flooding and snowstorms being a low risk. Another wind-related risk related to the possible changes in future wind energy resource with annual average windspeeds at 60m decreasing in future climate change scenarios. The report (EPA 2021) states that the overall trend is a decrease that reaches –2.4% in the southeast of Ireland, and –2.3% in the north of the country, for the medium- to low-emission scenario. There is a slight increase (<1%) in the 60m wind speed in some areas in the east and south of Ireland under the high-emission scenario. However, the report also states that the research associated with the future wind projects has a high level of uncertainty.

With respect to road infrastructure, which is required to maintain access to the proposed development, the EPA states that fluvial flooding and coastal inundation/coastal flooding are considered the key climate change risks with snowstorm and landslides being medium risks. Extreme winds and heatwaves/droughts are considered low risk to road infrastructure. One of the key outputs of the research was a framework that will provide quantitative risk-based decision support for climate change impacts and climate change adaptation analysis for infrastructure.

13.4. Likely Significant Impacts

13.4.1. Do Nothing Scenario

Under the Do-Nothing Scenario construction works will take place as per the Permitted Development. With respect to fugitive dust and particulate matter emissions and emissions from equipment and machinery will also occur, the impacts will not differ substantively from the impacts associated with the proposed development. Therefore, the construction phase no-nothing scenario can be considered as per discussed Section 12.4.2 in terms of air quality.

Under the Do Nothing Scenario slightly less construction works will take place and the calculated embodied CO_2 emissions will differ, due to bigger turbines the volume of concrete per foundation increases from 500 m^3 to 675 m^3. However, the larger turbines in the proposed scenario also have a greater power output and therefore the embodied carbon during construction will be offset during operation.

The Permitted Development is predicted to generate 98 GWh per annum (using a capacity factor of 34% from Eirgrid and installed capacity of 33 MW) of renewable, clean wind energy. However, this potentially increases to approximately 140 GWh per annum for the Proposed Development. Under the Do Nothing scenario c.40 GWh per annum of renewable energy will not be generated. The EPA have predicted that Ireland will continue to exceed its climate targets in future years and therefore reduction measures are required in all sectors (EPA, 2022c). The Proposed Development will help in Ireland meeting its climate targets for future years at both a national and EU level, under the Do-Nothing scenario this will not occur. The Do-Nothing scenario is considered significant, long-term and negative in terms of climate.

13.4.2. Air Quality - Assessment of Effects During Construction

13.4.2.1. Construction Traffic & Materials

This assessment focuses on identifying the existing baseline levels of PM_{10} and $PM_{2.5}$ in the region of the Proposed Development by an assessment of EPA monitoring data. Thereafter, the effect of the construction phase of the Proposed Development on air quality was determined by a qualitative assessment of the nature and scale of dust generating construction activities associated with the Proposed Development based on the guidance issued by the IAQM (2014).

Construction phase traffic also has the potential to impact air quality. The TII guidance Air Quality Assessment of Specified Infrastructure Projects – PE-ENV-01106 (TII, 2022a), states that road links meeting one or more of the following criteria can be defined as being 'affected' by a Proposed Development and should be included in the local air quality assessment. While the guidance is specific to infrastructure projects the approach can be applied to any development that causes a change in traffic.

- Annual average daily traffic (AADT) changes by 1,000 or more;
- Heavy duty vehicle (HDV) AADT changes by 200 or more;
- Daily average speed change by 10 kph or more;
- Peak hour speed change by 20 kph or more;
- A change in road alignment by 5m or greater.

The above scoping criteria have been used in the current assessment to determine the road links required for inclusion in the modelling assessment. The construction stage traffic is, as described in detail in Chapter 5 Material Assets - Traffic and Transport, below the above criteria therefore no further impact assessment is required and impacts are considered temporary and imperceptible and do not need to be considered further.

13.4.2.2. Construction Dust

In terms of air quality, the greatest potential impact during the construction stage will be from dust emissions associated with the construction works. The key works included in this development with the potential for dust emissions include earthworks and excavation activities, construction of hardstanding areas and movement of vehicles on and off site.

Construction works taking place within the Proposed Development site will result in some dust emissions, particularly during earthwork activities. However, there are no properties within 350m of the redline boundary. In addition, there is no sensitive designated ecology receptor within 50m of the redline boundary. Therefore, while focused measures will be implemented to ensure there will be no impact on properties located on the construction delivery route (e.g. deliveries subject to Traffic Management Plan, public roads inspected regularly; delivery loads covered, where necessary, and adherence to speed limits) as set out in Section 13.5.1, the likelihood of affect from construction dust on sensitive receptors is imperceptible and temporary.

To ensure any potential impacts are minimised, a Dust Management Plan will be formulated based on best practice measures associated with low risk of dust impacts and included in Section 3.7 (Dust Control) of the Construction Environment management Plan (CEMP). The Dust Management Plan will be reviewed at regular intervals during the construction phase to ensure the effectiveness of the procedures in place and to maintain the goal of minimisation of dust through the use of best practice and procedures. When the dust mitigation measures detailed in the mitigation section of this chapter (Section 13.5.1) are implemented, fugitive emissions of dust from the site will remain imperceptible and temporary and will pose no nuisance or human health impacts at nearby receptors.

13.4.3. Climate - Assessment of Effects During Construction

The construction phase of the Proposed Development will result in a number of GHG emissions from various sources. Embodied carbon is carbon dioxide emitted during the manufacture and construction of materials, and the turbine. As part of the proposed development, construction stage and operational GHG emissions are

considered through the use of the Scottish Carbon Calculator for wind farms on Scottish peatlands (Scottish Government 2023). The tool's purpose is to assess, in a comprehensive and consistent way, the carbon impact of wind farm developments. The tool considers the GHG emissions required for the construction and operation of the windfarm, including peat or forestry loss and compares this carbon costs of wind farm developments with the carbon savings attributable to the wind farm.

Detailed project information including volumes of materials such as concrete, turbine power output, capacity factors and peat depths were obtained for the purposes of this assessment. Information is broken down into the following areas:

- Characteristics of peatland before windfarm development;
- Characteristics of bog;
- Forestry plantation characteristics;
- Fossil fuel emission factors;
- Borrow Pits;
- Access Tracks;
- Foundations and hard-standing area associated with each turbine;
- Cable Trenches;
- Improvement of C sequestration at site by blocking drains, restoration of habitat etc;
- Restoration of site after decommissioning; and
- Will the habitat of the site be restored on decommissioning?

The calculations include the loss of a carbon sink associated with peat loss due to the construction of the Permitted and Proposed Development and the combined loss of 18.15 ha of forestry(15.7ha permitted and 2.45ha proposed).

The Scottish Carbon Calculator (Scottish Government 2023) estimated that the Permitted Development has embodied emissions of 46,209 t CO_2eq associated with it, this rises to 64,514 t CO_2eq for the Proposed Development due to the larger turbine sizing and resultant larger foundations. This is an increase of 18,305 t CO_2eq. The payback time associated with the generation of renewable energy rather than this energy being sourced from fossil fuels remains the same across the Permitted and Proposed Developments. This payback period is 6 months, using the Scottish Carbon Calculator site specific approach, compared to if the energy was generated using coal powered plants.

The predicted embodied emissions can be averaged over the full construction phase and the lifespan of the Proposed Development to give the predicted annual emissions to allow for direct comparison with national annual emissions and targets. Emissions have been compared against the carbon budget for the electricity sector in 2030 (EPA 2022d) and against Ireland's EU 2030 target of a 30% reduction in non-ETS sector emissions based on 2005 levels (33 million tonnes CO_2eq) (set out in Regulation EU 2018/842 of the European Parliament and of the Council). The total annual increase in GHG emissions in the construction phase (18,305 t CO_2eq) of the proposed development, annualised over its 25 years lifespan is equivalent to 0.056% of the total carbon budget for the electricity sector in 2030 (EPA 2022d) or 0.0020% of Irelands EU ESD Targets for 2030.

13.4.4. Air Quality - Assessment of Effects During Operation

The assessment of baseline air quality in the region of the Proposed Development has shown that current levels of key pollutants are significantly lower than their limit values. Due to the size, nature and remote location of the proposed development, increased road traffic emissions, resulting from the Proposed Development are expected to have an imperceptible impact on air quality during the operational phase. The road traffic emissions are associated with occasional visits from a maintenance team (up to four staff) to the Site. There is no change in operational traffic volumes between the Permitted and Proposed Development.

However, the additional generation of electricity due to the Proposed Development will lead to a net saving in terms of NO_X emissions. The wind farm will have a conservative estimated export capacity of up to approximately 46.86 MW (11 x 4.26 MW) and an assumed capacity factor of 34%, therefore the conservative estimate of power generation from the Proposed Development, (including the Permitted Development combined with the Proposed Development) is expected to be approximately 140 GWh per annum. The actual export capacity of the Proposed Development will vary depending on the final choice of turbine, with the potential increased generating capacity for the two turbine options being 13.86MW and 16.5MW respectively, and the annual output range of between approximately 140 and 150 GWh per annum. The capacity factor of 34% is based on an Eirgrid study for future windfarm developments in Region B (Page 11, Eirgrid, 2021). Of the estimated 140-150 GWh per annum, approximately 100 GWh per annum are already associated with the Permitted Development and therefore only approximately 40 - 50 GWh per annum are due to the additional capacity from the proposed development.

The conservative estimate of a supply of 140 GWh of renewable electricity to the national grid will lead to a net saving in terms of NO_X emissions which may have been emitted from fossil fuels to produce electricity. Results, outlined in Table 13.15, indicate that the impact of the wind farm on Ireland's obligations under the Gothenburg Protocol and the Directive (EU) 2016/2284 targets are positive. The annual impact of the development is to decrease annual NO_X emission levels by 0.321% of the NO_X emissions associated with power generation in Ireland in 2020 (EPA, 2022b). The total NO_X emissions savings over its 25-year lifespan will amount to over 430.6 tonnes of NO_X which is equivalent to 8% of the total NO_X emissions from fossil fuel power generation in 2020 or 0.49% of the total Irish NO_X emissions in 2021. This is considered a slight positive, long-term impact to air quality.

Scenario	NO_X (tonnes/annum)
Emissions Saved Due To Permitted and Proposed Development Note 1	19.2
National Emission Ceiling Note 2	41,698
Positive Impact of Wind farm (%) (as a percentage of National Emission Ceiling on an annual basis)	0.05%
Total NO_X Saving (%) Over 25 Years Relative To NO_X Emissions From Power Generation in 2020	8.0%

Note 1 For NO_X emissions associated with power generation in Ireland (taken from EPA (2022b) Ireland's Air Pollutant Emissions 1990 – 2030)

Note 2 National Emission Ceiling (EU Directive 2016/2284) applicable from 2030

Table 13.15 Predicted Impact of Cnoc Rathainí (Knockranny) Windfarm on Ireland's National Emissions Ceiling Obligations for 140 GWh (Permitted and Proposed Development)

Considering only the increased supply of renewable electricity due to the Proposed Development compared to the Permitted Development. The increased supply of 41 GWh of renewable electricity to the national grid will lead to a net saving in terms of NO_X emissions which may have been emitted from fossil fuels to produce electricity. Results, outlined in Table 13.16, indicate that the impact of the wind farm on Ireland's obligations under the Gothenburg Protocol and the Directive (EU) 2016/2284 targets are positive. The annual impact of the development is to decrease annual NO_X emission levels by 0.06% of the NO_X emissions associated with power generation in Ireland in 2020 (EPA, 2022b). The total NO_X emissions savings over its 25-year lifespan will amount to over 142 tonnes of NO_X which is equivalent to 2.38% of the total NO_X emissions from power generation in 2021 or 0.095% of the total Irish NO_X emissions in 2020. This is considered a slight positive, long-term impact to air quality.

Scenario	NO_X (tonnes/annum)
Emissions Saved Due To Proposed Development Note 1	5.7
National Emission Ceiling Note 2	41,698
Positive Impact of Wind farm (%) (as a percentage of National Emission Ceiling on an annual basis)	0.006%
Total NO_X Saving (%) Over 25 Years Relative To NO_X Emissions From Power Generation in 2021	12.38%

Note 1 For NO_X emissions associated with power generation in Ireland (taken from EPA (2022b) Ireland's Air Pollutant Emissions 1990 – 2030)

Note 2 National Emission Ceiling (EU Directive 2016/2284) applicable from 2030

Table 13.16 Predicted Impact of Cnoc Rathainí (Knockranny) Windfarm on Ireland's National Emissions Ceiling Obligations for 41 GWh (Proposed Development)

13.4.5. Climate - Assessment of Effects During Operation

GHGA

The Scottish Carbon Calculator for wind farms on Scottish peatlands (Scottish Government 2023) was used to calculate the operational phase impacts of the proposed development. Over the 25 year lifetime of the Proposed Development it will generate an additional 1,032,016 MWh compared to the Permitted Development, or 3,489,196MWh in total. The difference between the two figures is the additional capacity supplied as a result of the proposed development. The most recent (2021) figure for carbon intensity of electricity in Ireland is 347.8 gCO_2eq/kWh (SEAI 2023). Based on this carbon intensity there is an additional operational phase carbon emission saving of 14,357 tonnes CO_2eq annually from the Proposed Development compared to the Permitted Development. If no consideration is given to the already Permitted Development, which includes smaller turbines, the overall emission saving is 48,542 tonnes CO_2eq annually due to the proposed development.

The total annual GHG emission savings of the Proposed Development over 25 years will amount to approximately 358,935 tonnes of CO_2eq (14,357 tonnes CO_2eq x 25 years), at the 2021 carbon intensity, which is equivalent to 11.9% of the total carbon budget for the electricity sector in 2030 (EPA 2022d) or 1.09% annually. When the embodied energy from construction is removed, the annual emission savings are equivalent to 11.7% of the total carbon budget for the electricity sector in 2030 (EPA 2022d) or 1.07 % annually.

This project will assist in the CAP 2023 goal of producing up to 80% renewables for the grid. Considering the significance criteria set out in PE-ENV-01104 (TII 2022d) and Section 13.2.6 for the impact of the construction and operational phase, the impact of GHG emissions from the proposed project aligns with Ireland's GHG trajectory to net zero by 2050 as per TII Guidance (TII), this is therefore considered a significant positive, long-term impact to climate.

CCRA

A risk assessment has been conducted for potentially significant impacts on the Proposed Development associated with climate change during the Operational Phase. The risk assessment assesses the likelihood and consequence of potential impacts occurring and then provides an evaluation of the significance of the impact using the framework set out in Section 13.2.6.2.

Potential impacts are considered in accordance with the likelihood categories set out in Section 13.2.6.2 (Table 13.17), which take account of designed in mitigation, in combination with the exposure analysis (Table 13.18) in order to assess the significance conclusion (Table 13.19).

Examples of potential climate impacts during operation are included in Annex D (Climate proofing and environmental impact assessment) of the technical guidance on the climate proofing of infrastructure (European Commission 2021a). Potential impacts of climate change of the Proposed Development include:

- Flood Risk due to increased precipitation, and intense periods of rainfall. This includes fluvial and pluvial flooding;
- Increased temperatures potentially causing drought, wildfires and prolonged periods of hot weather;
- Reduced temperatures resulting in ice or snow;
- Geotechnical impacts; and
- Major Storm Damage – including wind damage.

Each of these potential risks are considered with respect to the operational phase of the proposed development. An initial scoping of the risk assessments has been conducted, in line with technical guidance on the climate proofing of infrastructure in the period 2021-2027 (European Commission 2021) and PE-ENV-01104 (TII 2022d).

Sensitive Receptors (Project Assets)	Sensitivity to Climate Hazards (No consideration of site location)								
	Flood (coastal, pluvial or fluvial)	Extreme Heat	Extreme Cold	Drought	Wind	Wildfire	Fog	Lightning & Hail	Landslides
Turbines	1	1	1	2	2	1	1	1	1
Drainage	2	1	1	1	1	1	1	1	1
Access Tracks	2	1	1	1	1	1	1	1	1
Buildings	2	1	1	1	1	1	1	1	1
Underground Utilities	1	1	1	1	1	1	1	1	1

Table 13.17 Sensitivity to Climate Hazards (with design mitigation in place)

Climate Exposure	Exposure Risk to Climate Variable (Consider the site location)								
	Flood (coastal, pluvial or fluvial)	Extreme Heat	Extreme Cold	Drought	Wind	Wildfire	Fog	Lightning & Hail	Landslides
Without exposure at project location	1	1	1	1	2	1	1	1	2

Table 13.18 Exposure Risk to Climate Hazards

Assets	Vulnerability Analysis								
	Flood (coastal, pluvial or fluvial)	Extreme Heat	Extreme Cold	Drought	Wind	Wildfire	Fog	Lightning & Hail	Landslides
	2 (Low Risk)	1 (Low Risk)	1 (Low Risk)	2 (Low Risk)	4 (Medium Risk)	1 (Low Risk)	1 (Low Risk)	1 (Low Risk)	2 (Low Risk)

Table 13.19 Vulnerability Analysis to Climate Hazards

The EPA's Critical Infrastructure Vulnerability to Climate Change report (EPA 2021) assesses the future performance of Irelands critical infrastructure when climate is considered. Wind farms are considered to be vulnerable to a medium risk of wind related impacts, with flooding and snowstorms being a low risk. When considering the proposed development, the additional vulnerability due to the Proposed Development over the Permitted Development should be considered.

Wind turbines are vulnerable to extreme storms because the maximum wind speeds in those storms can exceed the design limits of wind turbines – the likelihood of such events occurring will be increased with future climate change. The foundations and turbines will be designed to withstand the severe wind loads in accordance with IS-EN1991-1-4 (wind loading). With these design measures in place to ensure additional wind loading due to climate change are considered the sensitivity reduces to medium, the vulnerability decreases.

Chapter 8 of the EIAR reviews the potential for flood risk at the site via OPW Indicative Flood Maps (www.floodmaps.ie) and CFRAM Preliminary Flood Risk Assessment (PFRA) maps. The nearest flood event to the site in the Lough Corrib catchment occurred south of Moycullen village, which is located 5km to the southeast, while the nearest flood event in the Owenaboliska- Cashla-Screeb catchment occurred north of Boliska Lough. No flood events have been recorded within or in the vicinity of the site or the local access route from Doon. There is no additional vulnerability with respect to flooding due to the proposed development compared to the Permitted Development.

The risk of wildfires is negligible for the turbines due to areas of hardstanding surrounding them. However, the proposed structure will be designed in accordance with IS-EN 1991-1-5 (temperature loads) and will include additional temperature due to climate change (2 degrees Celsius). There is no additional vulnerability with respect wildfires due to the Proposed Development compared to the Permitted Development.

Drought is considered to have a low potential for risk, however it may impact soil stability. There is no additional vulnerability with respect to drought due to the Proposed Development compared to the Permitted Development.

As per Chapter 7, an assessment on landslide susceptibility was conducted across the wind farm site. The overall analysis of the impacts, in the light of the proposed mitigation measures, concludes that all of the potential impacts are negligible magnitude for the proposed development.

Lightning and hail are not deemed to pose an unusual risk to the structure, as standard with lighting protection measures will be designed into the turbine. There is no additional vulnerability with respect to lightning and hail due to the Proposed Development compared to the Permitted Development.

Fog is unlikely to have an adverse effect on the turbines.

There is no additional vulnerability with respect to all climate hazards when the Proposed Development is compared to the Permitted Development, with the exception of wind loading which increases with the height of the turbines. Design mitigation has been put in place in order to alleviate this known vulnerability to future climate change risk.

13.4.6. Air Quality and Climate - Assessment of Effects During Decommissioning

It is considered that the decommissioning effects of the Proposed Development will not be altered from those of the Permitted Development as outlined in the EIS. The decommissioning effects for the Project will be in line with those of the construction phase. An outline decommissioning plan is contained in the CEMP in Appendix 2.1

13.5. Mitigation Measures and Monitoring

13.5.1. Air Quality - Construction Phase

The Proposed Development has been assessed as having a low risk of dust soiling impacts and dust related human health impacts during the construction phase as a result of earthworks, construction and trackout activities (see Section 12.4.2.2). Therefore, the following dust mitigation measures shall be implemented during the construction phase of the proposed development. These measures are appropriate for sites with a low risk of dust impacts and aim to ensure that no significant nuisance occurs at nearby sensitive receptors. The mitigation measures draw on best practice guidance from Ireland (DCC, 2018), the UK (IAQM (2014), BRE (2003), The Scottish Office (1996), UK ODPM (2002)) and the USA (USEPA, 1997). These measures will be incorporated into the overall Construction Environmental Management Plan (CEMP) prepared for the site. The measures are divided into different categories for different activities.

Communications

- The name and contact details of a person to contact regarding air quality and dust issues shall be displayed on the site boundary, this notice board should also include head/regional office contact details.

Site Management

- During working hours, dust control methods will be monitored as appropriate, depending on the prevailing meteorological conditions. Dry and windy conditions are favourable to dust suspension therefore mitigations must be implemented if undertaking dust generating activities during these weather conditions.
- A complaints register will be kept on site detailing all telephone calls and letters of complaint received in connection with dust nuisance or air quality concerns, together with details of any remedial actions carried out.

Preparing and Maintaining the Site

- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.
- Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.
- Fully enclose specific operations where there is a high potential for dust production and the site is active for an extensive period.
- Avoid site runoff of water or mud.
- Keep site fencing, barriers and scaffolding clean using wet methods.
- Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below.
- Cover, seed or fence stockpiles to prevent wind whipping.

Operating Vehicles / Machinery and Sustainable Travel

- Ensure all vehicles switch off engines when stationary - no idling vehicles.
- Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.
- Impose and signpost a maximum-speed-limit of 20 kph haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate).

Operations

- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.
- Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
- Use enclosed chutes and conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
- Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.

Waste Management

- Avoid bonfires and burning of waste materials.

Measures Specific to Construction

- Avoid scabbling (roughening of concrete surfaces) if possible.
- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.
- Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.
- For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust.

Measures Specific to Trackout

- A speed restriction of 20 kph will be applied as an effective control measure for dust for on-site vehicles.
- Street and footpath cleaning must be undertaken during the ground works phase to minimise dust emissions. This can be carried out using water-assisted dust sweeper(s). If sweeping using a road sweeper is not possible due to the nature of the surrounding area, then a suitable smaller scale street cleaning vacuum will be used.
- Avoid dry sweeping of large areas.
- Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
- Record all inspections of haul routes and any subsequent action in a site log book.
- Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).

Monitoring

- Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.
- Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked.

13.5.2. Climate - Construction Phase

The construction phase of the Proposed Development is predicted will be offset during operation. However, to ensure impacts are minimised as much as possible during the construction phase of the proposed development, all contractors will ensure that machinery used on site is properly maintained and is switched off when not in use to avoid unnecessary exhaust emissions from construction traffic. Consideration will be given to the reuse and recycling of materials where possible in order to reduce waste from the site.

13.5.3. Air Quality - Operational Phase

During the operational phase of the proposed development, the works onsite will be limited to maintenance associated with the wind farm components. All maintenance contractors that are on site will ensure that machinery used is properly maintained and is switched off when not in use to avoid unnecessary exhaust emissions from maintenance traffic.

No further mitigation measures are required during the operational phase of the Proposed Development as it is predicted to have a slight positive and long-term potential effect on ambient air quality at a national level.

13.5.4. Climate - Operational Phase

No further mitigation measures are required during the operational phase of the Proposed Development as it is predicted to have a significant, positive and long-term potential effect on climate emissions.

13.6. Residual Effects

13.6.1. Air Quality - Construction Phase

When the dust mitigation measures detailed in the mitigation section of this report (Section 13.5.1) are implemented, the residual effect of fugitive emissions of dust and particulate matter from the site will be imperceptible and short-term and will pose no nuisance, human health or ecology impacts at nearby receptors.

13.6.2. Climate - Construction Phase

All residual climate impacts associated with the construction phase will be offset by the operational phase. Residual impacts for climate should be considered over the lifespan of the project and therefore will be discussed as part of Operational Phase Impacts.

13.6.3. Air Quality - Operational Phase

The supply of additional renewable electricity to the national grid will lead to a net saving in terms of NO_X emissions which may have been emitted from fossil fuels to produce electricity. This is considered a slight positive, long-term impact to air quality.

13.6.4. Climate - Operational Phase

There are no predicted adverse potential effects to climate during the operational phase of the proposed development. When the embodied energy from construction is removed, the annual emission savings are equivalent to 7.6% of the total carbon budget for the electricity sector in 2030 (EPA 2022d) or 0.30% of Irelands EU ESD Targets for 2030.Considering the significance criteria set out in Section 13.2.6 for the impact of the construction and operational phase, the impact of GHG emissions from the proposed project aligns with Ireland's GHG trajectory to net zero by 2050 as per TII Guidance (TII), this is therefore considered a significant positive, long-term impact to climate.

13.6.5. Air Quality and Climate - Decommissioning Phase

The residual decommissioning impact of the combined Proposed Development and Permitted Development is considered to be unchanged from the impact of the Permitted Development alone as outlined in the EIS.

13.7. Cumulative Effects

13.7.1. Air Quality - Construction Phase

According to the IAQM guidance (2014) there is the potential for cumulative construction dust impacts to nearby sensitive receptors if the construction of the Proposed Development coincides with the construction phase of other developments within 350m of the site. The Permitted Development has the potential cumulative impact with the proposed development, however, with mitigation measures set out in Section 13.5.1 in place for both the proposed and consented development no significant cumulative impact with respect to construction phase air quality is likely.

A review of other recent planning permissions for the area was conducted as outlined in Chapter 1 of this report and it was found that there are no developments of significance with regard to potential construction dust impacts within 350m of the proposed development. Therefore, there is no potential for cumulative dust impacts. Should any developments occur, the dust mitigation measures outlined in Section 13.5.1 will be applied throughout the construction phase of the Proposed Development which will avoid significant impacts on air quality.

13.7.2. Climate - Construction Phase

With respect to the requirement for a cumulative assessment PE-ENV-01104 (TII, 2022a) states that *"for GHG Assessment is the global climate and impacts on the receptor from a project* are not geographically constrained, the normal approach for cumulative assessment in EIA is not considered applicable."

However, by presenting the GHG impact of a project in the context of its alignment to Ireland's trajectory of net zero and any sectoral carbon budgets, this assessment will demonstrate the potential for the project to affect Ireland's ability to meet its national carbon reduction target. Therefore, the assessment approach is considered to be inherently cumulative.

IMEA significance (IEMA 2022) states that where the fundamental reason for a proposed project is to combat climate change (e.g. a wind farm) and this beneficial effect drives the project need, then it is likely to be significant. The Scottish Carbon Calculator (Scottish Government 2023) estimated that the cumulative GHG emissions from the construction phase of the Permitted and Proposed Development is 64,514t CO_2eq. The payback time associated with the cumulative generation of renewable energy rather than this energy being sourced from fossil fuels remains the same across the Project, with a payback period of 6 months, using the Scottish Carbon Calculator site specific approach, compared to if the energy was generated using coal powered plants. Considering the significance criteria set out in Section 13.2.6 for the impact of the construction and operational phase, the impact of GHG emissions from the proposed project aligns with Ireland's GHG trajectory to net zero by 2050 as per TII Guidance (TII), the cumulative impact is therefore considered a significant positive, long-term impact to climate.

This project will assist in the CAP 2023 goal of producing up to 80% renewables for the grid and 5 GW of onshore wind capacity.

13.7.3. Air Quality - Operational Phase

Considering the Proposed Development and Permitted Development cumulative impact of 140 GWh of renewable electricity the total NO_X emissions savings over its 25-year lifespan will amount to over 480.2 tonnes of NO_X which is equivalent to 8% of the total NO_X emissions from power generation in 2021 or 0.49% of the total Irish NO_X emissions in 2020. On a cumulative basis, the Proposed Development in conjunction with the other existing wind farm developments (available at SEAI website Wind Mapping System) within Ireland will cumulatively aid in reducing NO_X emissions from burning of fossil fuels for electricity production by providing clean, renewable electricity to the national grid. This will aid in Ireland achieving the national targets set out under the Gothenburg Protocol, Directive (EU) 2016/2284 and the 2023 CAP. Therefore, the Proposed Development will result in an overall, slight positive and long-term cumulative impact to air quality.

13.7.4. Climate - Operational Phase

With respect to the requirement for a cumulative assessment PE-ENV-01104 (TII, 2022a) states that *"for GHG Assessment is the global climate and impacts on the receptor from a project* are not geographically constrained, the normal approach for cumulative assessment in EIA is not considered applicable."

However, by presenting the GHG impact of a project in the context of its alignment to Ireland's trajectory of net zero and any sectoral carbon budgets, this assessment will demonstrate the potential for the project to affect Ireland's ability to meet its national carbon reduction target. Therefore, the assessment approach is considered to be inherently cumulative.

IMEA significance (IEMA 2022) states that where the fundamental reason for a proposed project is to combat climate change (e.g. a wind farm) and this beneficial effect drives the project need, then it is likely to be significant. This project will assist in the CAP 2023 goal of producing up to 80% renewables for the grid and 5 GW of onshore wind capacity when considered cumulative with other renewable energy projects.

Considering the significance criteria set out in Section 13.2.6, cumulative the impact of GHG emissions aligns with Ireland's GHG trajectory to net zero by 2050 as per TII Guidance (TII), this is therefore considered a significant positive, long-term impact to climate.

13.7.5. Air Quality and Climate - Decommissioning Phase

The cumulative decommissioning impact of the combined Proposed Development and Permitted Development is considered to be unchanged from the impact of the Permitted Development alone as outlined in the EIS.

13.8. Difficulties Encountered in Compiling Information

No significant difficulties occurred.

13.9. References

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CNOC RAITHNÍ (KNOCKRANNY) WIND FARM

CHAPTER 14

Population and Human Health

VOLUME II - EIAR

CHAPTER 14 – Population & Human Health

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Chapter 14

14. POPULATION AND HUMAN HEALTH

14.1. Introduction

14.1.1. Chapter Context

The 'Environmental Impact Assessment of Projects Guidance on the preparation of the Environmental Impact Assessment Report' 2017 specifies the following in relation to the assessment of population and human health:

> *Human health is a very broad factor that would be highly project dependent. The notion of human health should be considered in the context of the other factors in Article 3(1) of the EIA Directive and thus environmentally related health issues (such as health effects caused by the release of toxic substances to the environment, health risks arising from major hazards associated with the Project, effects caused by changes in disease vectors caused by the Project, changes in living conditions, effects on vulnerable groups, exposure to traffic noise or air pollutants) are obvious aspects to study. In addition, these would concern the commissioning, operation, and decommissioning of a Project in relation to workers on the Project and surrounding population.*

As noted in Figure 14.1, there are several inter-related environmental topics such as the potential impacts of the Proposed Development on air quality and climate, noise and vibration, shadow flicker, water, traffic and access, construction and waste management, which are of intrinsic direct and indirect consequence to human health. While the baseline scenario for these environmental topics is not duplicated in this section, in line with the EPA guidance 2022, the assessment of impacts on population and human health refers to those environmental topics under which human health effects might occur.

14.2. Assessment Methodology

This chapter of the EIAR has been prepared with reference to the Guidelines on the information to be Contained in Environmental Impact Assessment report, published by the EPA in May 2022, and has been informed by the EIAR policy and guidance documents listed in Section 1.4 of this report. A desktop study of the following published policy documents and data was undertaken to appraise the location and likely significant potential impact upon population and human health receptors and to assess population trends in the subject site and in the wider hinterland:

Population

- Central Statistics Office (CSO) Census 2011, 2016 and 2022 (preliminary) data;
- Galway County Development Plan 2022;
- Fáilte Ireland, EIAR Guidelines for the Consideration of Tourism and Tourism Related Projects;
- Failte Ireland 2008 study on "Visitor Attitudes on the Environment";
- BiGGAR Economics 2016, study on 'Wind Farms and Tourism Trends in Scotland'.

Human Health

- HSE Position Paper on Wind Turbines and Public Health (2017);
- The Institute for Environmental Management and Assessment (IEMA) UK issued a discussion document in 2017 (IEMA, 2017) on what a proportionate assessment of the impacts on health should be in EIA.
- Australian NHMRC Information Paper: Evidence on Wind Farms and Human Health 2015
- Health Canada 2014, Wind Turbine Noise and Health Study:
- In 2012, the New South Wales (NSW) Health Department provided written advice to the NSW Government
- Australian Medical Association, 2014, Wind farms and health

The following websites were also consulted:

- Fáilte Ireland (www.failteireland.ie/),
- Discover Ireland (www.discoverireland.ie),
- Connemara National Park (www.nationalparks.ie/connemara),
- Coillte (www.coillte.ie/our-forests/explore/).

For context and comparison purposes, Chapter 4 'Human Beings' of the Environmental Impact Statement (EIS)[1] for the Permitted Development was also consulted.

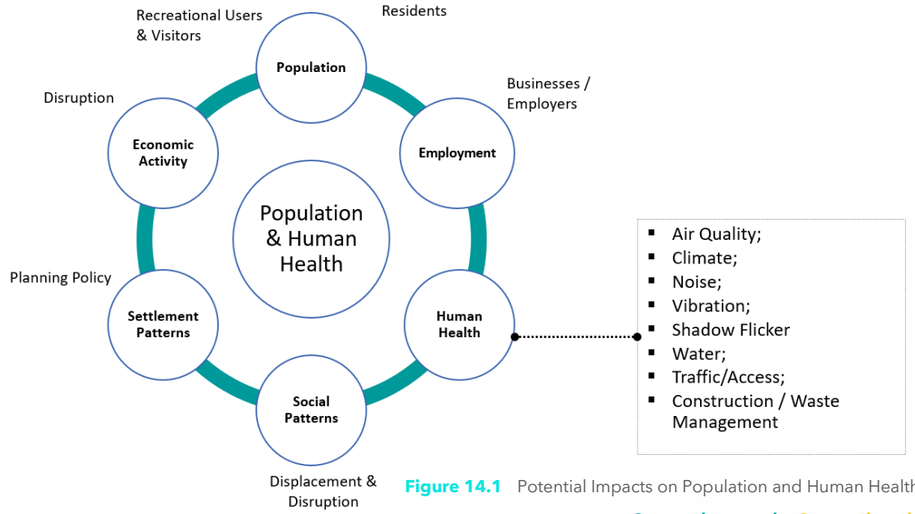

Figure 14.1 Potential Impacts on Population and Human Health

[1] Environmental Impact Statement for Knockranny Wind Farm Proposal prepared by Malachy Walsh and Partners in support of the permitted development -Galway County Council Reference 13/829 / An Bord Pleanala Reference PL07.243094.

This assessment is a study of the potential indirect and direct socio-economic impacts of the construction, operational and decommissioning phases of the Proposed Development. Effects on receptors were assessed in terms of magnitude, quality, significance and duration.

14.3. Baseline Conditions

14.3.1. Demographic Analysis

In assessing the demographic trends in the vicinity of the subject site an assessment of the relevant Central Statistics Office (CSO) boundaries has been conducted. The assessment of population and human health effects generally extends beyond the EIAR study area to include nearby population clusters. The Human Beings Chapter of the Permitted Development EIS was based on 2011 data and principally considered the subject development in relation to the Electoral Division (ED) of Sliabh an Aonaigh or Slieveaneena (ED 27062) within which it is located. EDs are the smallest legally defined administrative areas in the State. The EIS also included separate consideration of the following nearby settlements based on census settlement information:

Population	Centre	Direction
Roscahill	Village	3km NE
Moycullen	Village	4.5km SE
Oughterard	Town	9km N
Galway	City	15km SE

Table 14.1 Nearest Settlements

In the intervening time the 2016 Census has been published, and a census has been undertaken in 2022. At the time of writing only the preliminary census population figures have been published for the latter. While Census Small Areas, introduced in 2011, provide fine grain demographic data, as yet only ED data is available for the 2022 Census. As recent settlement population data is not available, a direct comparison with the EIS data is not available. To capture the demographic information pertaining to these nearby settlements the demographic analysis study area has been extended to include four additional EDs which contain the nearby settlements of Roscahill, Moycullen and Oughterard.

The study area for this section of the EIAR therefore comprises the following EDs as depicted in Figure 14.2:

- Slieveaneena (Sliabh an Aonaigh) - 27062;
- Wormhole - 27162;
- Tullokyne (Tulaigh Mhic Aodháin) - 27065;
- Moycullen (Maigh Cuilinn) - 27059;
- Oughterard - 27159.

14.3.1.1. Population

The subject site is rural in nature and relatively sparsely populated with no dwellings within the EIAR study boundary and few in the general vicinity, as reflected in the fact that there are no houses within 1km of any of the turbines, the nearest being 1.033km from T8. There is a pattern of low-density, one-off dwellings along the L-5348, L-5368 and L-5347 local roads to the east of the subject site, which increases in density closer to the N59, c. 2.6km from the site.

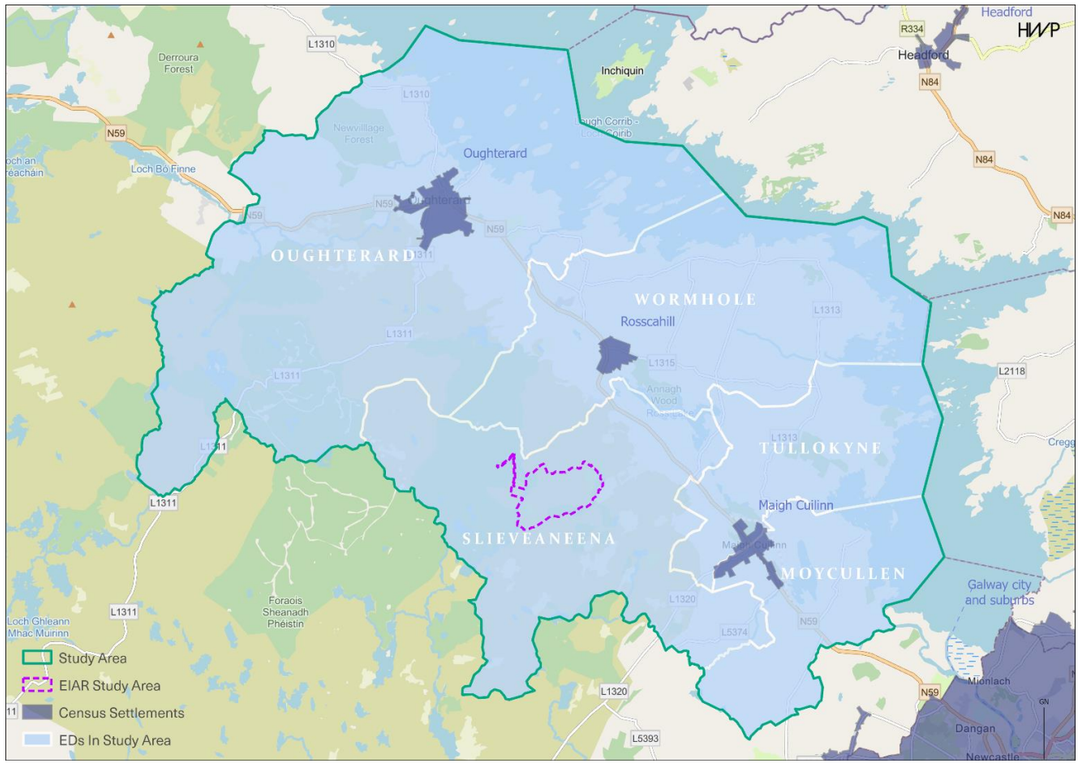

Figure 14.2 Demographic Analysis Study Area

Electoral Division	2011	2016	Change (%)		2022	Change (%)	
Maigh Cuilinn, 27059	2,008	2,142	*134*	*6.7%*	2,447	*305*	*14.2%*
Oughterard, 27159	2,604	2,625	*21*	*0.8%*	2,820	*195*	*7.4%*
Sliabh an Aonaigh, 27062	763	763	*0*	*0*	817	*54*	*7.1%*
Tulaigh Mhic Aodháin, 27065	1,985	2,075	*90*	*4.5%*	2,296	*221*	*10.7%*
Wormhole, 27162	2,315	2,376	*61*	*2.6%*	2,592	*216*	*9.1%*
Study Area Total	9,675	9,981	*306*	*3.2%*	10,972	*991*	*9.9%*
County Galway (inc. City)	250,653	258,058	*7,405*	*3.0%*	276,451	*18,393*	*7.1%*
State	4,588,252	4,761,865	*173,613*	*3.8*	5,123,536	*361,671*	*7.6*

Table 14.2 Population Change 2011 to 2022 in Demographic Analysis Study Area in the Context of Galway County and the State.

In the 2022 Census the population growth rate for the state since the 2016 Census was 7.6%, double that of the last intercensal period between 2011 and 2016. A similar trend is evidence in Table 14.2 for County Galway where the rate increased from 3% to 7.1%. Even stronger growth was experienced in the demographic study area, where the rate increased from 3.2 % to 9.9%.

However, this is primarily accounted for by exceptional strong growth (14.2%) in the ED of Moycullen (Maigh Cuilinn), containing an eponymous settlement which has consistently experienced strong growth since its 1991 population of 545. The settlement straddles the boundary with the ED of Tullokyne (Tulaigh Mhic Aodháin), which also experienced good growth of 10.7%. Located c. 12km from Galway City, it is considered that these trends reflect, in part, the shift to rural dwelling by some Galway City commuters. An above average growth rate is also evident in the ED of Wormhole (9.1%), where the settlement of Rosscahill is located. At c. 19km from Galway City this growth can also be attributed, in part, to its location within commuting distance from the city. While Oughterard ED experienced a low level of growth between 2011 and 2016 (0.8%), it also achieved a growth rate above the county average between 2016 and 2022 (7.4%).

The ED of Slieveaneen (Sliabh an Aonaigh), in which the subject site is located, experienced growth in line with the county average (7.1%) in the last intercensal period. However, Table 14.2 indicates, that it is starting from a low base, and had a population density in 2016 of just 14 persons per km^2. This is very low compared to the surrounding EDs where the density ranges from 23 – 89 persons per km^2 and compared to the overall density of Galway County which is 45 persons per km^2. This low density is explained by the absence of a settlement within the ED as indicated in Figure 14.3.

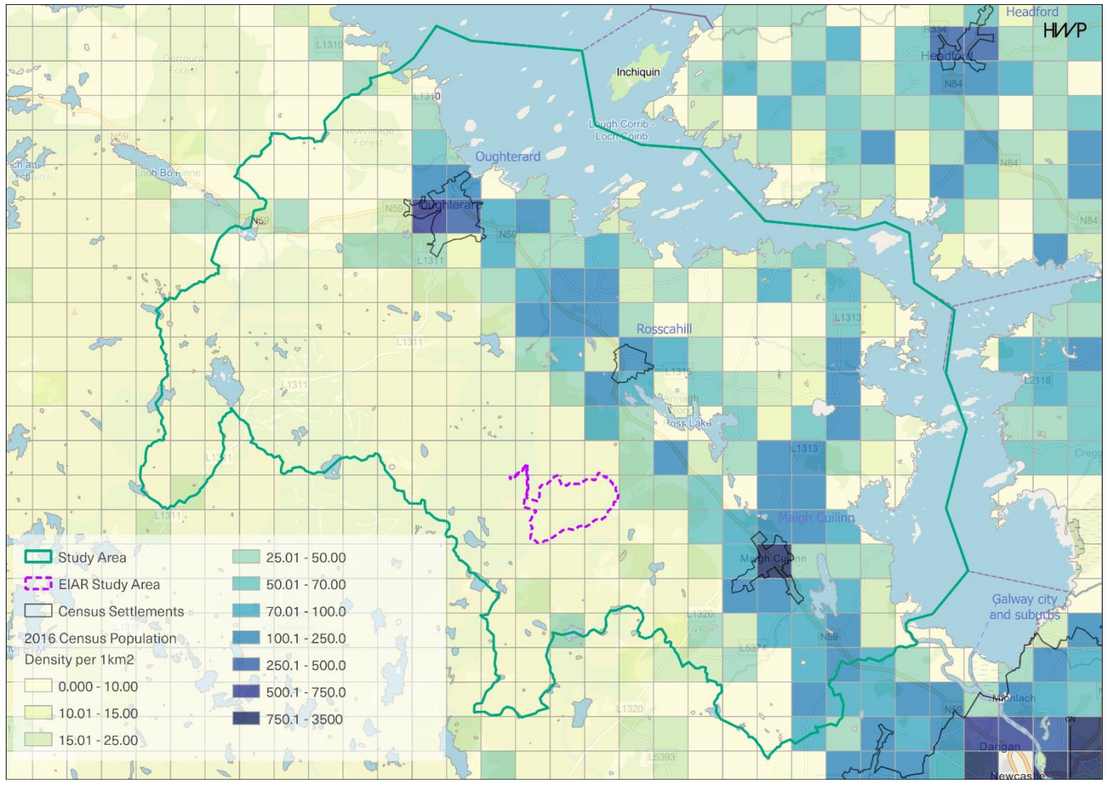

Figure 14.3 2016 Population Density per 1km Grid Square

The 2016 Census population density per 1km grid square figures provide a more detailed picture of the settlement distribution. As Figure 14.3 indicates, within the Slieveaneen (Sliabh an Aonaigh) ED, and within the demographic study area as a whole, the population is concentrated almost entirely within a c. 2km corridor of the N59. Outside of this area Lough Corrib accounts for the low population densities along the north-east. The subject area falls within the sparsely populated southwestern portion of the demographic study area, where the population densities are predominantly 10 persons per 1km^2.

At the time of writing the population age related data had not yet been published from the 2022 Census. In the 2016 Census the proportion of the Study Area population within each age category is similar to those recorded at national and county level for most categories. Within the Study Area, as in the county and state, the highest population percentage occurs within the 0 – 18 age category. The number of young adults between the ages of 18 – 24 is slightly lower than the state and county average. This is counterbalanced by the higher than average percentage of the population in the 45 – 64 age cohort. This pattern is consistent with that expected of a predominantly rural population, where younger people leave for educational and employment reasons.

Area	0 - 18	19 – 24	25 - 44	45 - 64	65 +
	Age Category				
State	26%	7%	30%	24%	13%
County Galway (inc. City)	32%	10%	23%	22%	13%
Study Area	30%	6%	24%	28%	13%

Table 14.3 - 2016 Age Category Information

Preliminary 2022 Census data of note that has been published is information indicating whether the population change at a county level is attributable to natural increase or net migration. While Table 14.2 indicates that the population growth rate to 2022 in Galway and the state are similar at 7.1% and 7.6% respectively, Table 14.4 demonstrates that the larger portion of this increase nationally is due to net migration, whereas in Galway it is due to natural increase.

	Natural increase -%	Estimated net migration %
State	47%	53%
County Galway	52%	48%

Table 14.4 Components of Population Change 2016 - 2022

14.3.1.2. Employment and Economic Activity

The Labour Force comprises of those who are able to work and are 15 years and older. This excludes persons in full-time education, those looking after the home, retired or unable to work. The 2022 census employment data was not available at the time of writing, however, from the 2016 Census (ref Table 14.5) it can be seen that the

Labour Force Participation Rate, at 61.2% is in line the county and national figures. However, with 91% of the labour force at work, the study area has a higher employment rate than Galway City, County or the state average. Conversely, the unemployment rate of 9% is significantly lower than the county and state averages which range from 11.7% to 12.9%. The percentages of the population in the study area looking after the home, unable to work, retired and students are generally intermediate values between those of Galway City and Galway County, reflecting the study area's transitional location between urban and rural regions. The relatively high number of students resident in the area initially appears at odds with the slightly lower than average percentage of population aged between 19 and 24 years (ref. Table 14.3).

% of Total Pop Aged 15 years and Over			State	Galway County	Galway City	Study Area
In the Labour Force (LF)			61.4%	61.3%	61.3%	61.2%
% of LF who are	*At Work (as % of LF)*		*87.1%*	*88.3%*	*87.1%*	*91.0%*
% of LF who are	*Unemployed (including 1st time job seekers) (as % of LF)*		*12.9%*	*11.7%*	*12.9%*	*9.0%*
Unemployed (have left employment)			7.1%	6.5%	6.9%	5.0%
Looking for First Job			0.8%	0.7%	1.0%	0.5%
Looking after Home/Family			8.1%	8.7%	5.5%	7.7%
Unable to Work			4.2%	4.1%	3.3%	3.4%
Retired			14.5%	14.8%	12.2%	14.3%
Student			11.4%	10.7%	17.1%	13.1%

Table 14.5 2016 Census Employment Information

However, when the relatively low first-time jobs seekers population figure of 0.5% is considered in comparison to Galway City's figure of 1%, it appears to indicate that the students in this age cohort may remain living in the area, while the first-time jobseekers move to the city to find work.

The Permitted Development EIS noted that in the 2011 Census both the male and female population within the Slieveaneen (Sliabh an Aonaigh) ED were predominantly occupied in professional services. This pattern continues to prevail in the 2016 Census for the wider study area, with 25% of the workforce engaged in professional occupations. In 2016, the skilled trades represented the second highest occupation sector at 14%, closely followed by associated professional and technical occupations and administration and secretarial occupations. This differs from the pattern noted in the Slieveaneen ED in 2011, where manufacturing, commerce and trade were common occupations. Notwithstanding these changes, it can be concluded that these are all predominantly urban occupations related to work within Galway City. This is supported by the 2016 Census data which shows that over the study area the most common journey time for the population aged 5 years and older travelling to work, school or college is 30 – 45 minutes. This roughly equates to the commuting time to Galway City. Oughterard, which is slightly outside the commuter belt for Galway City does not conform with this pattern, with local commuting of up to 15 minutes predominating. In addition, Moycullen's relative proximity to Galway City results in the commuting time of 15 – 30 minutes (the journey time to Galway City) prevailing.

Electoral Division	Commute Time of 30 – 45 minutes	Electoral Division	Commute Time of 30 – 45 minutes
Maigh Cuilinn, 27059	28%	Tulaigh Mhic Aodháin, 27065	34%
Oughterard, 27159	21%	Wormhole, 27162	33%
Sliabh an Aonaigh, 27062	32%	Study Area Total	29%

Table 14.6 2016 CSO Census - % of Population with 30 – 45-minute Journey to Work, School and College Travel Times by ED

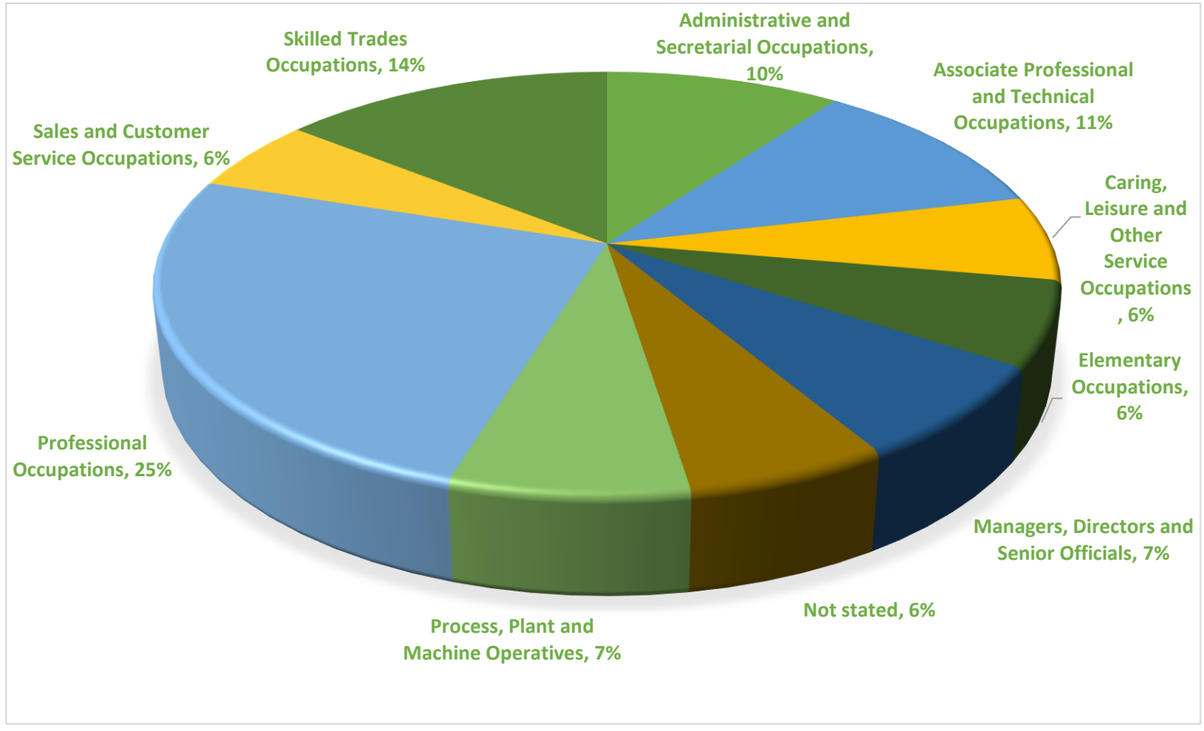

Figure 14.4 2016 CSO Census Occupation by ED

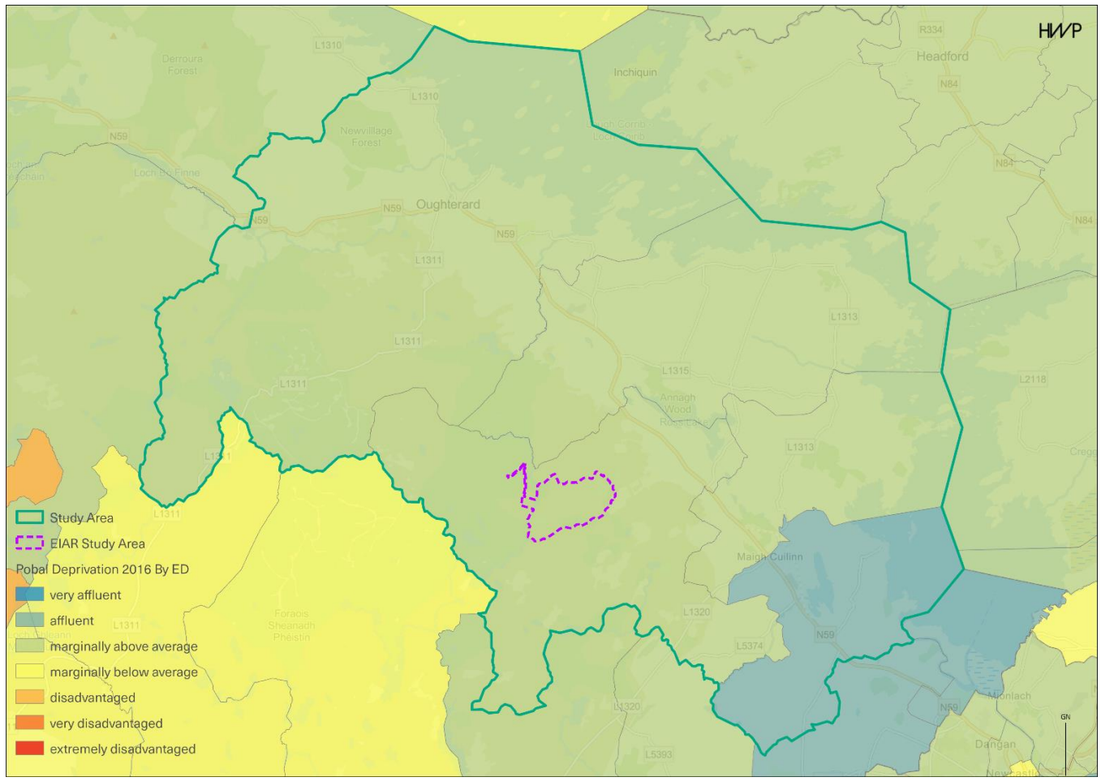

Figure 14.5 Pobal Deprivation Index 2016

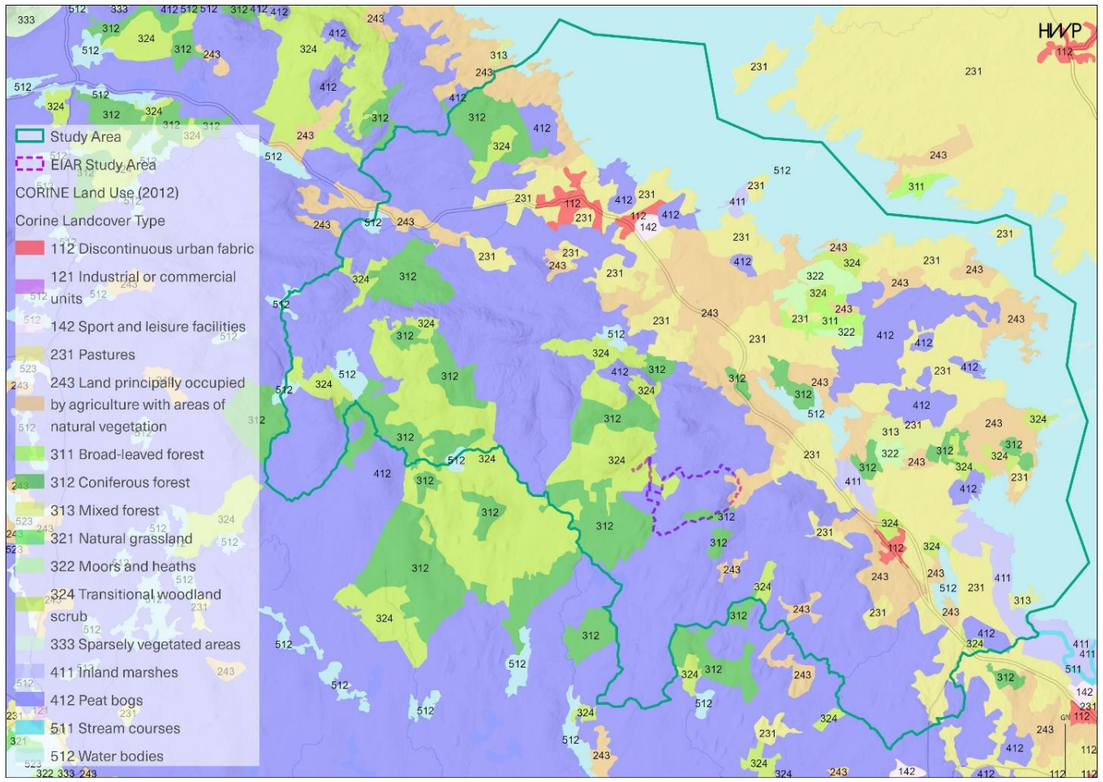

Figure 14.6 Corine Land Use Data

The high level of employment in the study area is reflected in the Pobal Deprivation Index Mapping 2016 which shows the four EDs in the study area as 'marginally above average', with an area to the south considered 'affluent'. To the south-west of the study area in the Connemara Bog Complex there are areas 'marginally below average' and 'disadvantaged'.

14.3.1.3. Land Use

There is a notable dichotomy in the topography of the study area, with lands to the north-east identified in the Galway County Development Plan as a Lake Environs Landscape Character Area and the lands to the south-west defined as an Uplands and Bog Landscape Character Area. The route of the N59 approximates the boundary between these two landscape types, with undulating lands to its south-east which range in height from 15m to 288m and are characterised by bog, heath and commercial forestry. The Connemara Bog Complex (Special Conservation Area – SAC and Special Protection Area - SPA straddling the south-western boundary. To the north-east the lands are predominantly flat sloping gently eastwards to the shore of Lough Corrib (SAC and SPA), comprising rough grazing pasturelands, waterbodies, with discrete areas of peat bog and small settlements. There has been a tradition of turf cutting/turbary in both areas. The subject site is just outside the Connemara Bog Complex SAC where turf cutting is prohibited. Anecdotal evidence suggests there has been a sizeable increase in the use of turbary rights, particularly in Galway, since the start of the energy crisis in 2022.

The subject site is privately and state owned and commercial forestry covers areas to the south and north-west of site.

Based on the 2020 CSO Census of Agriculture there were 467 agricultural holdings in the study area, this has reduced from 482 by the 2010 Census of Agriculture, in line with the 3.4% national decline in farm numbers in the period. From Table 14.7 it is apparent that the average size of the farms is relatively small ranging from 12.8 hectares in Wormhole to 26.5 hectares in Sliabh an Aonaigh. The average farm size nationally is 33.4 hectares. The overall percentage of the study area farmed is 31%, however, this ranges from just 25% in Oughterard to 42% in Sliabh an Aonaigh.

ED	no. of farms	area (Ha)	average size	% of ED in ag use
Maigh Cuilinn, 27059	47	1019	21.7	37%
Oughterard, 27159	132	2972.3	22.5	25%
Sliabh an Aonaigh, 27062	91	2409.8	26.5	42%
Tulaigh Mhic Aodháin, 27065	56	1041.9	18.6	36%
Wormhole, 27162	141	1810.3	12.8	30%
Study Area Total	467	9253.3	19.8	31%

Table 14.7 CSO 2020 Agricultural Census Data

Significantly, there are a number of existing windfarms, including the 174MW Galway Wind Park to the west of the study area. The 25 turbine Ardderroo wind farm is immediately west of the Permitted Development turbine locations and is currently under construction, the Proposed Development includes grid connection works via the Ardderroo substation. These and other existing and permitted wind farms are listed in Table 14.8.

Farm Name	Owner	No. of Turbines	Proximity to Development Lands	Status
Ardderroo Wind Farm	Ardderroo Windfarm Ltd	25	27m	Under construction
Inverin	Fuinneamh Teoranta	5	10.4km southwest	Existing
Cloosh	Coillte Teoranta and SSE Renewables (Ireland)Ltd	22 (20)	4.3km west	Existing
Uggool	SSE Renewables (Ireland) Ltd	16	2.6km northwest	Existing
Seecon	Coillte Teoranta and SSE Renewables (Ireland) Ltd	23 (16) *	5.2km southwest	Existing
Seecon & Cloosh	Coillte Teoranta and SSE Renewables (Ireland)Ltd	9*(change of spec)	4 – 5km west	Permitted
Lettercraffroe	SSE Renewables (Ireland) Ltd	8	7.3km northwest	Existing
Knockalough Wind Farm	Knockalough Wind Farm Ltd	12	3km south	Existing
Leitir Gungaid (Lettergunnet)	Coir na Gaoithe Teoranta	10	6.9km south -southeast	Existing
Letterpeck (Shannagurran & Truskaunngappul)	Enerco Energy Ltd	7	5.3km south	Existing

Table 14.8 Other Windfarms in the Vicinity

14.3.1.4. Services and Community Resources

A range of services and urban amenities are focused in the nearby settlements. The nearest to the Proposed Development site being the village of Rosscahill, located c. 3km to the north-east on the N59 between Moycullen and Oughterard. The N59 also provides access to Moycullen, which is c. 4.5km to the south-east, and Oughterard c. 9km to the north-east, both are designated as Small Growth Towns – *'key service centres and drivers for growth'* in the GCDP. Galway City is located c. 15km from the subject site.

Moycullen offers a certain amount of local employment, with jobs in the service sector, such as retail and restaurants along with a modest amount of industrial and enterprise type jobs. The GCDP contains lands zoned for future business, enterprise and industrial use and notes that the town has the potential to become more self-sufficient through the creation of new employment opportunities.

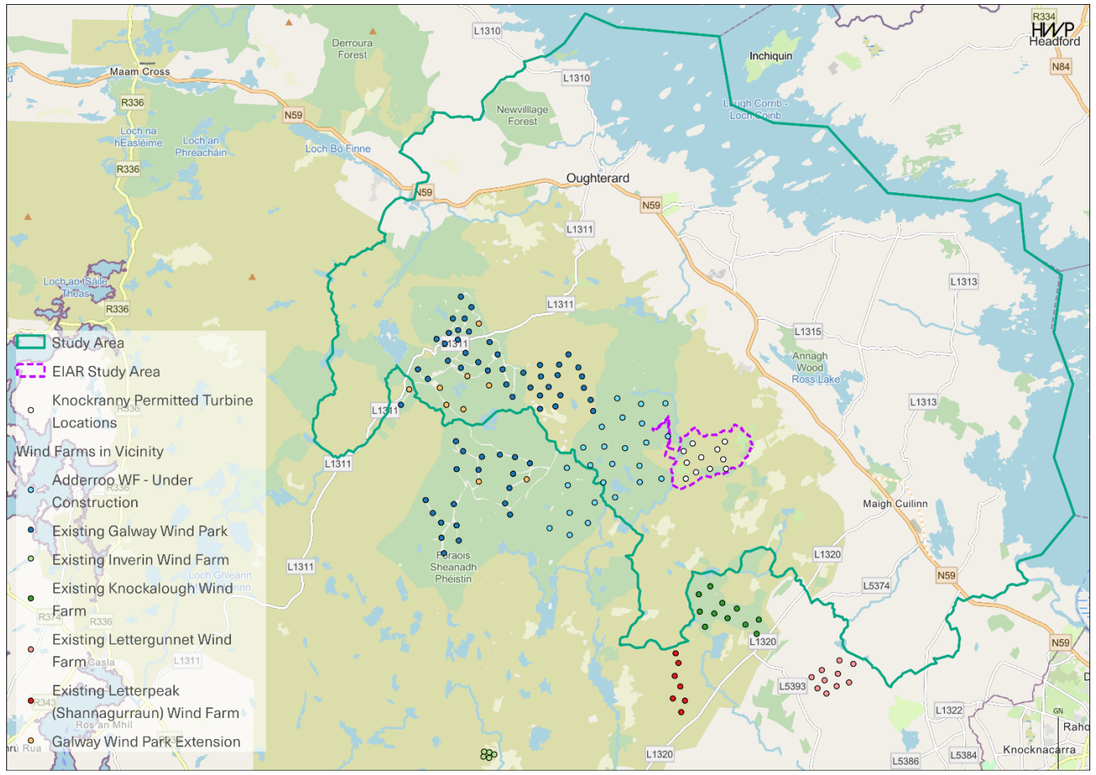

Figure 14.7 Wind Farms in Vicinity

It has a large hinterland, which illustrates its strategic role in providing services and facilities for the local residents of these areas. In addition, it has a number of key community facilities which are important amenities to the town and wider hinterland. These include the children's playground, creche, primary school, church and graveyard, medical facilities, Garda Station, post office, a number of sporting facilities (including GAA and handball facilities), two nursing homes and a new primary care centre. Work on the delivery of a by-pass of the town is currently underway.

Oughterard has extensive local services and local employment opportunities and serves a large rural catchment. Its services include convenience type shopping, bank, post office, butcher, hairdresser, builders' yard, church and graveyard, medical facilities including a health centre, dentist and optician, Garda station, credit union, a community hall, library, resource centre, nursing home, restaurants and pubs as well as a creche, primary and secondary schools, playing pitches, and a playground. The tourism industry makes a significant contribution to the town's economy.

The south-west of the study area falls within the Connemara Gaeltacht area.

There are 6 no primary schools within the study area including:

- Scoil Náisiúnta Tullach Ui Chadhain (Tullykyne),
- Scoil Náisiúnta Tuairini (Scoil Cholmáin),

- Scoil Mhuire (Moycullen),
- Ainbhthin Naofa (St Annins),
- Scoil Náisiúnta Baile Nua (Newtown),
- Scoil Náisiúnta Uachtar Árd (Oughterard).

In addition, St Paul's Secondary School is located in Oughterard. Third level and other further education institutes are located in Galway City.

A range of sport and recreational facilities are present in the study are in the form of:

- A number of angling locations,
- Oughterard Golf Club,
- Killannin GAA Club
- Moycullen Handball Club
- Moycullen GAA Club
- Corrib Kayaks
- Connemara Equestrian
- Rosscahill Woods Trail
- Over Equestrian Centre
- Brigit's Garden.

14.3.1.5. Tourism and Recreational Amenity

Galway City and County are a popular tourist destination. In 2019, prior to the Covid 19 pandemic, it was estimated that 1.6 million international visitors and 1.1 million domestic visitors generated a combined tourism revenue of €743 million[2]. With the population of County Galway in the 2022 Census recorded as 276,451, the annual number of visitors equates to c. 10 times the population. The economic significant of this sector is evident in the fact that 12-14% of businesses in Galway City and County are involved in tourism and the sector accounts for 21,000 jobs across the county.

However, due to the pandemic, international air-based visitor numbers to the country as a whole were down by 63.7% in 2020, and 64.7% in 2021 from the 2019 pre-Covid figure. Similarly, the domestic visitor numbers to County Galway in 2021 decreased by 48% to 573 thousand visitors. In 2022 this trend was beginning to reverse nationally, with the international air-based visitors numbers being only 12% less than the 2019 figure. Indeed, the Fáilte Ireland Tourism Barometer for December 2022 noted that 46% of accommodation operators had more guests in 2022 compared with pre-Covid norms, with the domestic market playing an important role in the tourism recovery. However, this must be viewed in the context that some accommodation operators have closed permanently or not yet re-opened for the tourism sector since Covid. The non-accommodation sectors are still largely down on pre-Covid norms. While the tourist volumes are still in flux following the impact of the pandemic, it is expected that this sector will revert to pre-Covid norms in the coming years and continues to play a significant role in County Galway's economy.

In the context of the study area, the N59, linking Galway City and the west, is a popular tourist route part of which forms the Galway Clifden Scenic Route. Oughterard, on the Owenriff River at the shore of Lough Corrib, is an important location for angling and fishing and hosts a number of competitions annually. As well as being considered the main angling centre in the area, Oughterard is regarded as the Gateway to Connemara with the Western Way long distance walking and hiking trail running from Oughterard to Connemara. The Connemara National Park covers 2,957ha of mountains, bogs, heaths, grasslands and woodlands, in western Co. Galway and includes some of the Twelve Bens or Beanna Beola mountain range.

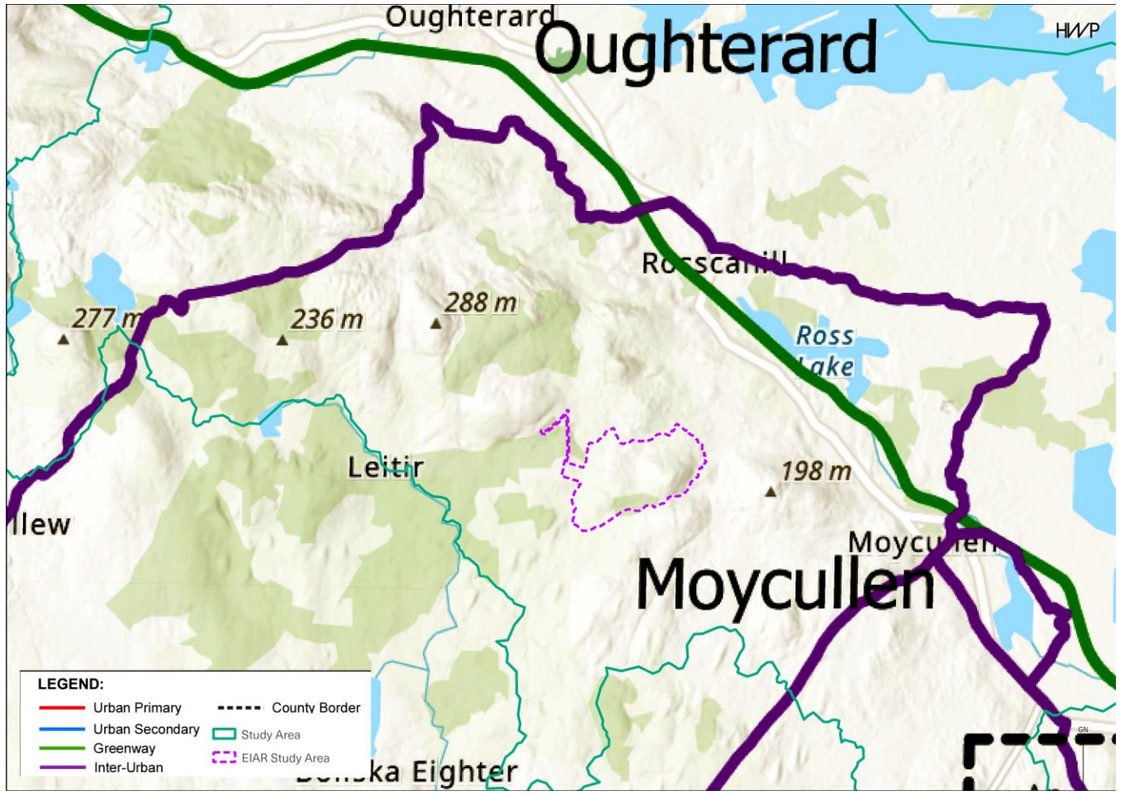

Figure 14.8 Extract from Draft CycleConnects Plan

The Permitted Development EIS noted that the following Coillte amenity areas are in the vicinity of the Proposed Development:

- Newvillage Forest Recreation Area - Approximately 2kms northwest of Oughterard village in Co. Galway along the Glann Road;

[2] Galway County Development Plan 2022 – 2028, Section 8.5

- Derroura Mountain Bike Trail - trails are located approximately 7kms to the west of Oughterard between the N59 road and Lough Corrib in Co. Galway; and
- Lackavrea - located approximately 3km north east of Maam Cross in the heart of Connemara.

In addition, the following walking and recreation areas fall within the study area:

- Western Way
- Roscahill Woods Trail,
- Killarainey Woods Walk,
- Moycullen (Maigh Cuilinn) Heritage Trails - Killagoola Loop Walk
- Leitir Mast Hiking Area,
- Lough Buffy Hiking Area,
- Cody's Cross hiking Area.

There are also proposals to extend the Connemara Greenway from Oughterard to Galway City as indicated in Figure 14.8.

As part of the adjacent Ardderroo Wind Farm development, which is currently under construction, an on-site recreation and amenity area is permitted which will consist of looped trails based on the access tracks developed to serve the wind energy development, as well as toilet and car parking facilities for visitors. Two looped walks will be located off a main linear road through the site. The Galway Wind Way is a range of recreational trails at the Galway Wind Park as indicated in Figure 14.9.

14.4. Likely Significant Impacts

14.4.1. Do Nothing Scenario

If the Proposed Development were not to proceed the already Permitted Development will proceed under the terms of the planning permission granted (Galway County Council Planning Ref. No. 13/829 and An Bord Pleanála Ref: 07.243094). The opportunity to increase the energy output from County Galway's valuable renewable energy resource would be lost, as would the opportunity to further contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions.

The environmental impact, as envisaged in the Permitted Development EIS would pertain. The Human Beings element of the Matrix of Impacts from that study is included in Table 14.9. The impacts are predominantly neutral or minor, with a significant impact anticipated only in relation to the operational stage of the landscape and visual impact assessment. Chapter 4 of the Permitted Development EIS concludes that:

> *'The project is being developed and managed to minimize the impact on the human environment and the local residents. With the mitigation measures in place, the potential negative impacts of the proposed wind farm on the local human environment are expected to be slight. The contribution to the local economy will signify a beneficial impact.*

Given that the development is in line with Government and EU targets, and will contribute to the national renewable energy portfolio, the development will be positive for the greater human environment.'

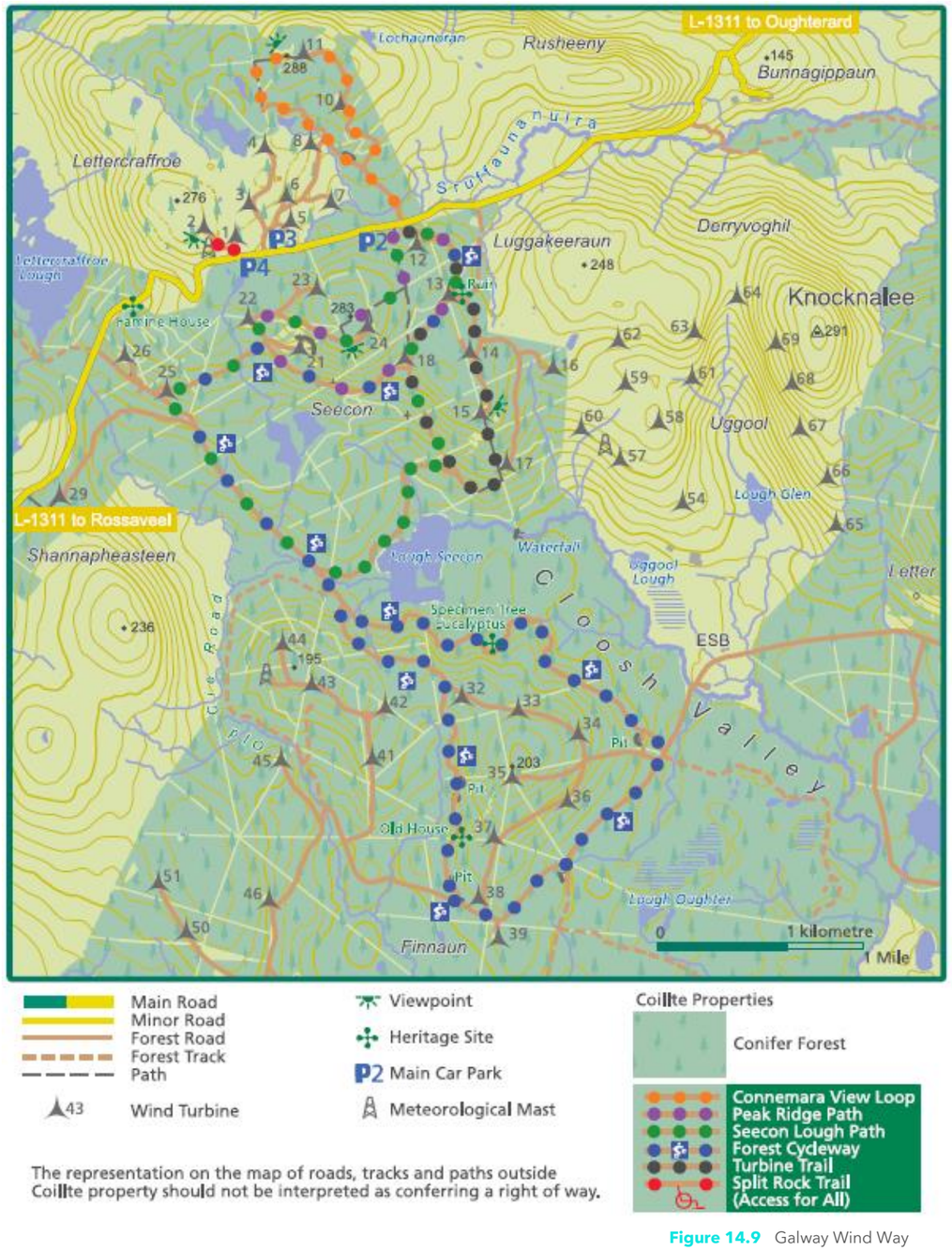

Figure 14.9 Galway Wind Way

Interaction		Air Quality & Climate	Cultural Heritage	Noise & -Vibration	Biodiversity	Shadow Flicker	Water (Hydrology & Hydrogeology)	Land, Soils & Geology	Material Assets – Services, Infrastructure & Utilities	Material Assets – Traffic & Transport	Landscape & Visual
Population & Human Health	Construction										
	Operation										
	Construction										
	Operation										
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	Operation										

Neutral/No Impact | Minor Impact | Major Impact

Table 14.9 The Human Being Element of the Matrix of Impacts in the Permitted Development EIS

14.4.2. Assessment of Effects During Construction

14.4.2.1. Population

Due to the nature of the Proposed Development, there is not expected to be any significant effects on the demographic or growth pattern of the study area. The Permitted Development EIS considered that as it is expected that a large proportion of construction personnel will be local, there will be no impact to the population during the construction phase.

The subject area falls within the sparsely populated southwestern portion of the study area, where the population densities are predominantly 10 persons per 1km^2. Recent population growth has been clustered around settlements and along the N59, at a distance from the subject site. Therefore, any further effects of the Proposed Development are considered to be neutral, imperceptible and short-term.

14.4.2.2. Employment and Economic Activity

A report entitled 'Economic Impact of Onshore Wind in Irish Ireland' was published in 2021 by KPMG, on behalf of Wind Energy Ireland. It noted that almost 40% of the country's electricity in 2020 was provided by wind farms with more than 5,000 people working in the industry. It anticipates that if targets set for onshore wind in the Climate Action Plan can be achieved, this will rise to more than 7,000 people. In 2020 it estimated payment of €225 million was made in incomes to workers across the sector and supply chain, and c. €45 million was contributed to local authority rates. It predicts this will increase to €305 in workers' incomes by 2030 and up to €100 million in rates. In addition to direct jobs the sector creates indirect employment through capital activities, e.g. legal and financial advisory roles, electrical supply, storage and related services, and through spend by direct employees in local shops. Many of these jobs are focussed in areas outside of urban areas and are viewed as a critical component contributing to the economic development of regional and rural areas. The operational spend alone in the Northern and Western Region, including Galway, is calculated to c. €50 million. Wind Farm contributions can also account for a significant proportion local authorities' total commercial rates income (e.g. 22.0% and 15.5% of total income in Leitrim and Tipperary respectively). In 2020 it represented 7.3% of County Galway's commercial rates income, with an additional €2.2 million being spent in local contributions. These figures are set to increase significantly if 2030 CAP target are to be met.

Having regard to the existing commuter patterns in the study area, the local employment opportunities offered though wind energy development, would contribute towards counterbalancing the unsustainable commuter outmigration to Galway City that currently typifies the area.

In line with the KPMG report findings the Permitted Development EIS considered that the Permitted Development would have a '*positive impact on employment at both the local and national level and in both the short and long term*', in the form of professional services for site investigation, surveying and environmental assessment and the subsequent construction and operation phases. It noted the intention of the Applicant to require the main contractor to use local sub-contractors, drivers, suppliers and materials. Indirect positive effects arising from the construction phase on local economic activity are also envisaged.

The Proposed Development involves the omission of the on-site substation, modifications to the turbine specifications and grid connection to the Ardderroo Substation rather than the Knockranny Substation as considered in the Permitted Development EIS. It is envisaged that the magnitude of change on employment arising from these changes will be negligible and the general pattern of impacts on employment, as identified in the Permitted Development EIS, are not expected to change significantly. Any further effects of the Proposed Development are considered therefore to be neutral, imperceptible and short-term.

14.4.2.3. Land Use

As noted, the area is sparsely populated, with no dwellings in proximity to the subject site. Lands in the vicinity are currently in commercial forestry, small scale-agricultural and wind energy usage. The Permitted Development will result in the replacement of predominantly agricultural rough grazing land and commercial forestry with wind energy usage, which is already an accepted use in the vicinity. The Permitted Development EIS considered that there would be a neutral impact on land and soils.

During the construction phase, the principal amendments in the Proposed Development relating to Land Use are:

- the off-road section of cabling track to the south of the existing Arrderroo Wind Farm Substation access road (c.600m) running parallel to the existing Knockranny Substation
- the upgrading of the existing forestry road (c.600m) to tie in with the existing Arrderroo Wind Farm access road;

However, these works will be of a temporary duration and are not considered to result in any further significant impact on the land use of the area. The omission of the permitted on-site substation will result in a slight reduction in the lands-use change. Therefore, overall any effects arising from the Proposed Development are considered to be neutral, imperceptible and short-term.

14.4.2.4. Services and Community Resources

The Permitted Development EIS emphasizes that it was the intention of the Applicant that during the construction phase local services would be used where possible. It stated that:

> *'While the project is ongoing, the presence of personnel, including turbine manufacturer representatives, will support the local economy in terms of using local shops and sourcing meals and lodging in the locality. Additional personnel will be in the area during the commissioning of the wind farm.*

The Proposed Development will have no further significant effect. Therefore, any effects arising from the Proposed Development are considered to be neutral, imperceptible and short-term.

14.4.2.5. Tourism and Recreational Amenity

As noted in the Permitted Development EIS all green field developments have the potential to impact the landscape, during both the construction and the operation phases. However, it also noted that '*the development site is not currently used as a forest park or recreation site. There are no picnic facilities near the site or any direct tourist attractions or services at the site. Overall, it is considered that the construction of the wind turbines will not have any significant negative impact on tourism*'.

It should be noted (as outlined in Section 14.3.1.6) that the adjacent Ardderroo Wind Farm, once completed, will include a series of looped trails. These in conjunction with the existing Galway Wind Park recreation routes and other walking and hiking and cycling routes in the vicinity, will result in aspects of the construction phase of the Proposed Development being visible to a range of recreational users. Similarly, portions of the site may be visible from the N59, linking Galway City and the west, a popular tourist route part of which forms the Galway Clifden Scenic Route. In addition, construction traffic will be visible along this route. Chapter 4 – Landscape and Visual Impact of this EIAR considers that these are very minor changes in the context of physical land disturbance in this already modified forestry and wind farm setting. It concludes that the magnitude of landscape impacts during construction are deemed Negligible and the quality of the effect will be Neutral.

Overall, the magnitude of any increase in construction works or construction traffic arising from the Proposed Development is not considered to be significant. Therefore, impacts arising purely from the Proposed Development on tourism and recreational amenity are considered to be negative, short-term and slight.

14.4.2.6. Human Health and Residential Amenity

While it is noted above that landscape and visual impacts can affect human health and residential amenity during the construction phase of a wind energy development, other factors need also to be considered. A range of experiential factors have the potential to impact human health and residential amenity. These encompass nuisance arising from air quality (in particular construction dust) and climate, noise, vibration or traffic issues. There is also the potential of health impacts arising from pollution from emissions or accidental spillage to land or waterbodies.

The Permitted Development EIS identified no significant effects to human health in relation to any of these potential issues. Chapter 5 – Traffic and Transport of this EIAR models the traffic impacts of the Proposed Development on the surrounding roads during the construction phase and considers the effect to be negative, temporary and not significant.

There are no hazardous substances associated with the construction of the Proposed Development, beyond those routinely used in standard construction projects. The appropriate treatment and management of any such hazards are addressed in the accompanying CEMP (Appendix 2.1).

Chapter 12 - Noise and Vibration of this EIAR notes that the potential noise effects during the construction activities remain unchanged from those identified in relation to the Permitted Development. Overall, the effects of the construction phase were deemed to be negative, not significant and temporary. In relation to the amended turbine and hardstand construction and the grid connection construction elements, the magnitude of construction noise is considered not significant. In relation to the increased construction traffic it is considered to be imperceptible except along the L-53453 / Ardderroo Wind Farm access road local road and forestry road where it is considered to be slight to moderate. This latter assessment is the same as for the Permitted Development.

Chapter 13 Air Quality and Climate scoped out the impact from construction traffic as it is below the defined criteria whereby a proposed development should be included in the local air quality assessment. In terms of construction dust emissions, it considers the likelihood of affect from construction dust on sensitive receptors is imperceptible and temporary. When the dust mitigation measures detailed in Chapter 13 are implemented, fugitive emissions of dust from the site will remain imperceptible and temporary and will pose no nuisance or human health impacts at nearby receptors. In terms of climate, the payback time associated with the generation of renewable energy rather than this energy being sourced from fossil fuels remains the same across the Permitted Development and the Proposed Development. This payback period is 6 months, using the Scottish Carbon Calculator site specific approach, compared to if the energy was generated using coal powered plants.

14.4.3. Assessment of Effects During Operation

14.4.3.1. Population

Once operational it was envisaged in the Permitted Development EIS that one permanent job would be created locally in the form of operator and maintenance tasks, with additional personnel required occasionally for maintenance activities associated with the roads. No significant effect to the population of the area was envisaged. It is envisaged that the operational effect arising from the Proposed Development will not alter the findings or conclusions of the Permitted Development EIA, and therefore the effect on the population is considered to remain long-term, neutral and imperceptible.

14.4.3.2. Employment and Economic Activity

As noted in Section 14.4.3.1 above it was envisaged in the Permitted Development EIS that the Permitted Development would have a slight positive impact on employment in the area. No significant effect to the employment in the area was envisaged. It is similarly envisaged that the operational phase effect arising from the Proposed Development will be long-term, neutral and imperceptible.

14.4.3.3. Land Use

There is significant wind energy use extant in the wider area. The EIS considered that the Permitted Development would result in a neutral impact on land and soils. It noted that livestock could continue to graze on the site during the operational phase, if necessary, and forestry activities could continue at the site. There are no fences or barriers restricting access. In addition to the proposed wind farm use, the Permitted Development includes the creation of an education and heritage resource, based on the existing pre-famine farmstead on-site.

During the operational phase, the Proposed Development will not significantly alter the land use to that of the Permitted Development. Therefore, any effects arising from the Proposed Development are considered to be neutral, imperceptible and long-term-term.

14.4.3.4. Services and Community Resources

As set out in the Permitted Development EIS, Western Power Developments Limited has developed a funding proposal which will provide 1% of the annual wind farm revenue to the community for the lifetime of the project. These funds will be distributed locally for the benefit of the community in line with the IWEA Best Practice Principles.

The Proposed Development includes amendments to the turbine specification. These will result in an increase in estimated installed capacity for the 11-turbine wind farm, to between 46.9MW and 49.5MW per hour. The Proposed Development therefore has the potential to produce between 13.9MW and 16.5MW more output per hour than the Permitted Development which had an estimated maximum output of 33MW. As per the Permitted Development, the community benefit funding proposal will provide 1% of the annual wind farm revenue to the community for the lifetime of the Project over 25 years, in the form of a dedicated community benefit fund available for projects within a 20km radius. Based on the increased output of the Proposed Development there would be a consequent increase in fund arising from the increase in capacity.

Should the Proposed Development be developed under the Renewable Energy Support Scheme (RESS), it would attract contribution of €2/MWhr of electricity generated at the site. The value of this fund would be directly proportional to the electricity generated by the wind farm, and would be significantly increased due to the increased output arising from the Proposed Development. Therefore, any effects arising from the Proposed Development are considered to be positive, significant and long-term.

The Community Benefit Fund belongs to the local community. The premise of the fund is that it should be used to bring about significant, positive change in the local area. To make this happen, the first task will be to form a benefit fund development working group that clearly represents both the close neighbours to the project as well as nearby communities. This group will then work on designing the governance and structure of a community entity that would administer the Community Benefit Fund. The types of projects and initiatives that could be supported by such a Community Gain proposal could include youth, sport and community facilities, schools, educational and training initiatives, and wider amenity, heritage, and environmental projects.

14.4.3.5. Tourism and Recreational Amenity

Tourism and recreational amenity play an important economic and societal role in the study area. In this capacity the following literature review into the interaction between wind energy development and tourism is considered relevant.

According to a 2008, Fáilte Ireland study on '*Visitor Attitudes on the Environment*' nearly three quarters of those surveyed claimed that; '*potentially greater numbers of wind farms would either have no impact on their likelihood to visit or have a strong or fairly strong positive impact on future visits to the island of Ireland*.' The survey noted that the perception of the impact of wind farms was positive compared to other forms of development such as of housing, electricity steel pylons and mobile phone masts.

A further 2012 Fáilte Ireland study on tourism attitudes to wind farms[3] found that over half of the 1,000 domestic and foreign tourists who holidayed in Ireland during 2012 said that they had seen a wind turbine while travelling around the country. 21% considered they had a negative impact on the landscape, while 32% said that it enhanced the surrounding landscape, and 47% said that it made no difference to the landscape. Again, almost three quarters of respondents claimed that greater numbers of wind farms would either have no impact on their likelihood to visit or have a strong or fairly strong positive impact on future visits to the island of Ireland.

Similarly, research in Scotland by BiGGAR Economics in 2016, entitled 'Wind Farms and Tourism Trends in Scotland', examined trends at a local authority level and in the immediate vicinity of constructed wind farms. Of the eight local authorities that experienced a faster increase in wind energy deployment than the Scottish average, five of these also saw a larger increase in sustainable tourism employment than the Scottish average. The analysis indicated that in the majority of cases (66%) sustainable tourism employment performed better in areas surrounding wind farms than in the wider local authority area. Overall, the conclusion of the study was that there was no evidence to suggest that onshore wind farm development has had a detrimental impact on the tourism sector, even at the very local level.

[3] 'Fáilte Ireland Newsletter 2012/No.1 entitled 'Visitor Attitudes on the Environment: Wind Farms – Update on 2007 Research'

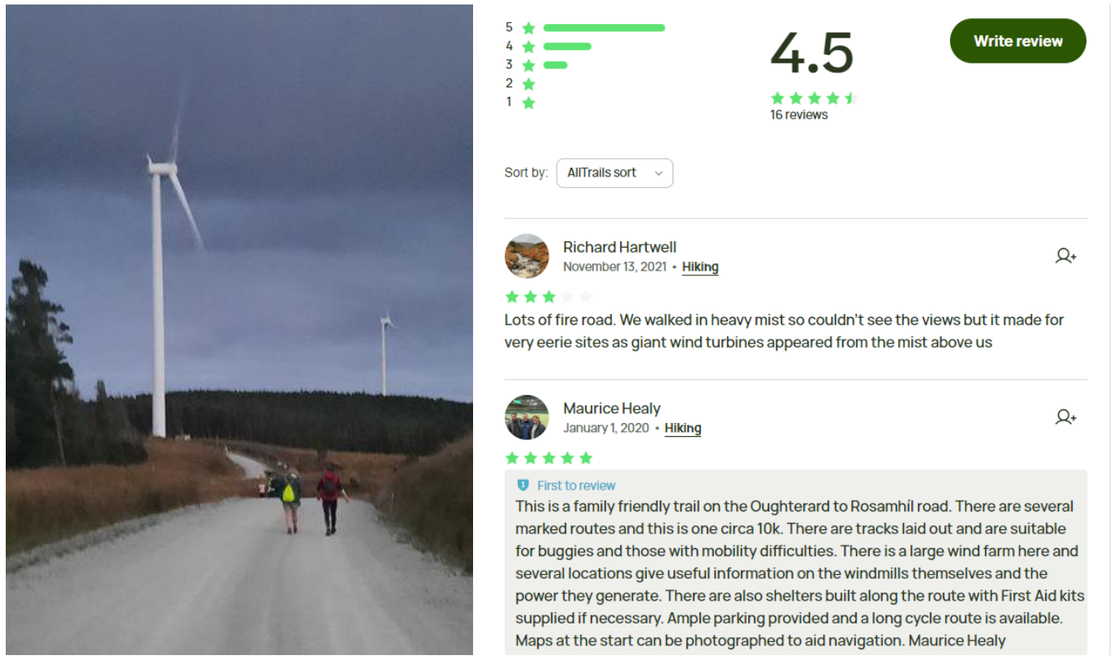

Figure 14.10 Galway Wind Park Review from www.alltrails.com.

This conclusion would appear to be supported by the success of the Galway Wind Way which is positively reviewed in a number of walking and hiking sites (ref. Figure 14.10). In line with this the Permitted Development includes the creation of an education and heritage resource based on the ruins of a pre-famine farmstead and field system within the site. This would open the site to the public and provide an opportunity to educate visitors on the site's heritage and on renewable energy. The Permitted Development EIS noted that this would be developed in conjunction with the Department of Arts, Heritage and the Gaeltacht and the county archaeologist and noted that:

> *'The site would welcome local visitors, school tours and overseas tourists, to learn about life in pre-famine Ireland, sustained by the burning of turf, in contrast with a modern wind farm. The development of this resource would present a positive impact of the proposal in terms of eco-tourism'.*

The Permitted Development EIS considered that in relation to land use or tourism and amenity there would not be a significant adverse impact. While the Proposed Development will result in a slight increase in the visibility of the turbines, it is considered that the revised turbines will fit into in the visual context of the receiving environment where 25 no. turbines are currently under construction in the adjacent Ardderroo Wind Farm which have a permitted hub height of 178.5m. As outlined in Chapter 4 any effects arising from the Proposed Development are considered to be negative, slight-imperceptible and long-term. Similarly, the significance of visual impacts at the c.21 viewpoint locations is deemed to be 'Imperceptible'.

14.4.3.6. Human Health and Residential Amenity

As evident from the image in Figure 14.10, the operational phase of wind turbines poses little threat to the health and safety of the general public enabling people or animals to safely walk up to the base of the turbines. This is highlighted by the fact that the Department of the Environment, Heritage and Local Government (DoEHLG)'s *'Wind Energy Development Guidelines for Planning Authorities 2006'* states that there are no specific safety considerations in relation to the operation of wind turbines. Fencing or other restrictions are not necessary for safety considerations. The DoEHLG Guidelines do note possible risk from flying ice or damaged blades, however, modern blad materials and design and the use of sensors to detect ice minimise these risks.

The rigorous safety checks imposed on the turbines during design, construction, commissioning and operation ensure that risks to humans are negligible. The safety and health record of the wind energy industry worldwide is exceptionally good. Wind energy has a better safety record than other forms of power production. Alongside this there is limited potential for significant natural disasters to occur in relation to wind energy development in Ireland.

In addition, as wind energy output supplies an increasing share of our national energy demand, there is a consequent significant reduction in carbon emissions associated with the burning of fossil fuels. During the operational stage the wind farm will have a slight positive long-term effect on air quality as set out in Chapter 13 which will contribute to positive effects on human health.

Notwithstanding the above, there is a perception that wind farms can have a negative impact on the health and residential amenity of those who live in their vicinity, principally from noise emissions and shadow flicker. There is also a perception that proximity to wind farms impacts property values.

- Causes of turbine noise

The moving parts of a wind turbine emit a certain amount of mechanical noise, predominantly from the gearbox (although not all turbines have gearing systems), and to a lesser extent the generator, cooling fans, oil pumps and other auxiliary equipment. Depending on the speed of rotation the mechanical noise may have a tonal component which can give the impression of a noise which is 5 dB or louder than the actual noise level. Modern wind turbine design incorporates insulation in the nacelle to reduce transmission of mechanical noise and vibration. Due to this it is unusual for tonal noise to be a significant factor.

Aerodynamic noise, arising from the speed at which the tips of the blade travels, can be fairly high due to the length of the blades in large wind turbines and is now the more dominant noise source. It can be controlled to a certain extent by careful blade design, however an element of residual noise is inevitable.

- Causes of shadow flicker

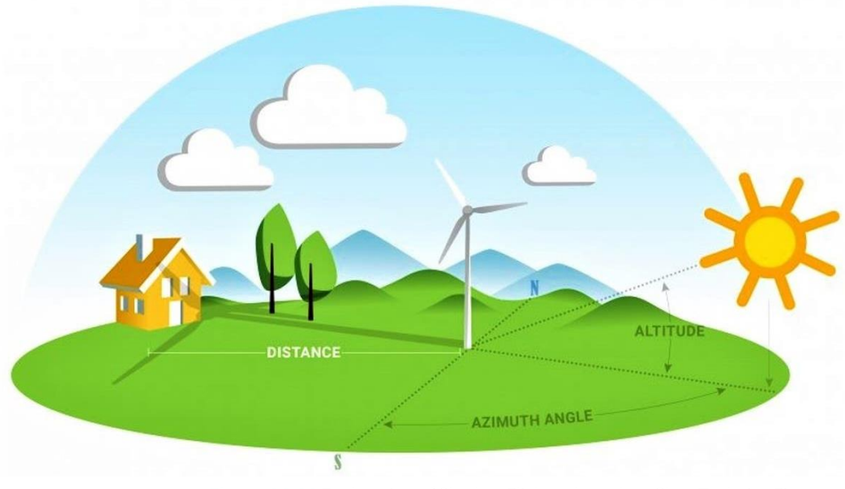

Figure 14.11 Explanation of Shadow Flicker – based on CleanTechnica Figure

Shadow flicker is a flickering phenomenon that may occur when rotating wind turbine blades pass between the sun and a nearby home, casting a periodic shadow (ref Figure 14.11). It generally only occurs for a few hours per year and its occurrence is curtailed by natural screening due to terrain or vegetation, and the orientation of and distance between the turbine and the house. Shadow flicker is more common around sunrise and sunset when the shadows are long since the sun is low on the horizon, it also generally only impacts properties within 130 degrees either side of north, relative to the turbines, as in Ireland and the UK, due to their latitude, turbines do not cast long shadows on their southern side.

The following literature review examines recent research in this area.

HSE PUBLIC HEALTH MEDICINE ENVIRONMENT AND HEALTH GROUP (2017)

The Health Service Executive (HSE) published a position paper on wind turbines and public health in February 2017 to address the rise in wind farm development and concerns regarding potential impacts on public health. The paper discusses previous observations and case studies in the context of a range of health effects that are perceived to be associated with wind turbine noise, shadow flicker and electromagnetic radiation. The position paper referenced a number of comprehensive reviews which examined whether there were proven health effects.

The HSE position paper determines that current scientific evidence on adverse impacts of wind farms on health is weak or absent. Further research and investigative processes are required at a larger scale in order to be more definitive. They recommend that developers use of the Draft Wind Energy Development Guidelines (2006[4]), as a means of setting noise limits and set back distances from the nearest dwellings.

THE NATIONAL HEALTH & MEDICAL RESEARCH COUNCIL (2015)

The Australian authority on health issues, the National Health and Medical Research Council (NHMRC), conducted a comprehensive independent assessment of the scientific evidence on wind farms and human health, published in the NHMRC Information Paper: '*Evidence on Wind Farms and Human Health 2015*', this report concluded:

> *'After careful consideration and deliberation, NHMRC concluded that there is no consistent evidence that wind farms cause adverse health effects in humans. This finding reflects the results and limitations of the direct evidence and also takes into account the relevant available parallel evidence on whether or not similar noise exposure from sources other than wind farms causes health effects.*

HEALTH CANADA (2014)

Health Canada, Canada's national health organisation, released preliminary results of a study into the effect of wind farms on human health in 2014[5]. The study was initiated in 2012 specifically to gather new data on wind farms and health. The study considered physical health measures that assessed stress levels using hair cortisol, blood pressure and resting heart rate, as well as measures of sleep quality. More than 4,000 hours of wind turbine noise measurements were collected and a total of 1,238 households participated.

No evidence was found to support a link between exposure to wind turbine noise and any of the self-reported illnesses. Additionally, the study's results did not support a link between wind turbine noise and stress, or sleep quality (self-reported or measured). However, an association was found between increased levels of wind turbine noise and individuals reporting of being annoyed.

NEW SOUTH WALES HEALTH DEPARTMENT (2012)

In 2012, the New South Wales (NSW) Health Department provided written advice to the NSW Government that stated existing studies on wind farms and health issues had been examined and no known causal link could be established.

NSW Health officials stated that fears that wind turbines make people sick are 'not scientifically valid'. The officials wrote that there was no evidence for 'wind turbine syndrome', a collection of ailments including sleeplessness, headaches and high blood pressure that some people believe are caused by the noise of spinning blades.

THE AUSTRALIAN MEDICAL ASSOCIATION (2014)

The Australian Medical Association put out a position statement, Wind Farms and Health 2014[6]. The statement said:

> *'The available Australian and international evidence does not support the view that the infrasound or low frequency sound generated by wind farms, as they are currently regulated in Australia, causes adverse health effects on populations residing in their vicinity. The infrasound and low frequency sound generated by modern wind farms in Australia is well below the level where known health effects occur, and there is no accepted physiological mechanism where sub-audible infrasound could cause health effects.'*

JOURNAL OF OCCUPATIONAL AND ENVIRONMENTAL MEDICINE (2014)

The review titled, Wind Turbines and Health: A Critical Review of the Scientific Literature was published in the Journal of Occupational and Environmental Medicine, 2014. An independent review of the literature was undertaken by the he Department of Biological Engineering of the Massachusetts Institute of Technology (MIT). The review took into consideration health effects such as stress, annoyance and sleep disturbance, as well as other effects that have been raised in association with living close to wind turbines. The study found that:

> *'No clear or consistent association is seen between noise from wind turbines and any reported disease or other indicator of harm to human health.'*

The report concluded that living near wind farms does not result in the worsening of the quality of life in that region.

NOISE

Chapter 12 of this EIAR examines the modelled potential worst-case effects at the nearest noise sensitive locations arising from the two candidate turbines being considered under the Proposed Development (Enercon E138 and Vestas E138) compared to the turbine specification (GE 2.85) considered in the Permitted Development.

The Permitted Development EIS' noise prediction calculations demonstrated that under worst case scenario conditions the lower fixed limit can be achieved at all locations both cumulatively and in isolation. Chapter 12 of this EIAR includes a comparison of the proposed candidate turbine models modelled noise outputs with those of

[4] Published prior to the Draft Wind Energy Development Guidelines 2019

[5] Health Canada 2014, Wind Turbine Noise and Health Study: Summary of Results. Available at https://www.canada.ca/en/health-canada/services/environmental-workplace-health/noise/wind-turbine-noise/wind-turbine-noise-health-study-summary-results.html

6 Australian Medical Association, 2014, Wind farms and health. Available at https://ama.com.au/position-statement/wind-farms-and-health-2014

the turbine specification assessed in the EIS. In the case of the Enercon E138 there was a reduction in noise levels of between -0.1 and -0.6 decibels. For the Vestas V136 there was a very slight increase of between 0.0 and 0.2 decibels. In both cases the change in noise level is considered to be imperceptible. The effect of the Proposed Development, (regardless of candidate turbine selected) is therefore considered to be neutral, long-term and imperceptible.

SHADOW FLICKER

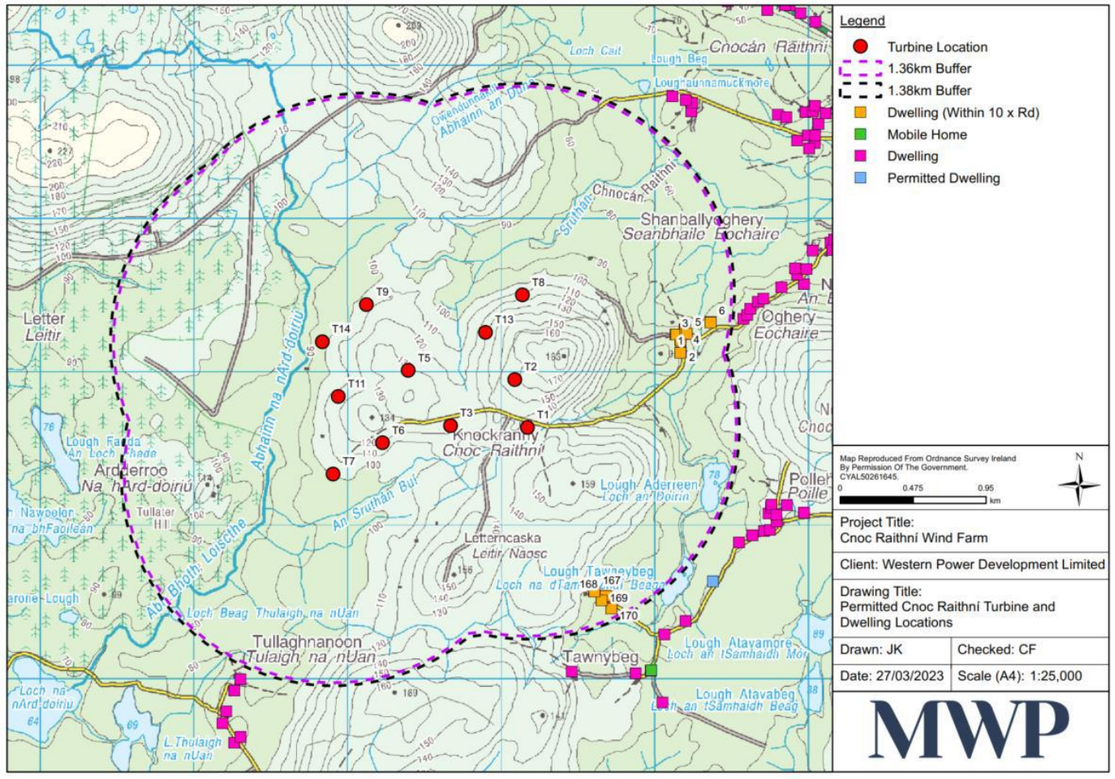

Figure 14.12 Residential Receptors within 10 Rotor Diameters of Turbines

A Shadow Flicker Analysis Report prepared by Malachy Walsh and Partners Engineering and Environmental Consultants is included in Appendix 14.1. The current 2006 Wind Energy Development Guidelines recommend that shadow flicker at offices and dwellings within 500m of a turbine should not exceed 30 hours per year or 30 minutes per day. There are no dwellings within 500m of a proposed turbine, therefore the development would comply with the recommended threshold criteria.

These guidelines also state that at distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low. The output from the Shadow Flicker model determines that Shadow flicker could theoretically occur at up to 6 properties, under theoretical conservative conditions, within the 10 rotor diameter study area.

The likelihood and duration of this effect occurring however depends upon certain combinations of factors namely sunshine, turbine and window locations, turbine orientation, weather conditions and intervening structures or vegetation. When average annual sunshine data is taken into account, the potential annual shadow flicker at all dwellings falls well below the best practice threshold of 30 hours per day.

Condition 9(a) of the Permitted Development stipulates that:

> *'Shadow flicker arising from the proposed development, by itself or in combination with other existing or permitted wind energy development in the vicinity, shall not exceed 30 hours per year or 30 minutes per day at existing or permitted dwellings or other sensitive receptors.*

The report by Malachy Walsh and Partners Engineering and Environmental Consultants includes a migation strategy. In the event of any shadow flicker exceedances, screening measures will be discussed with the affected landowner. If is it not possible to mitigate with screening measures, wind turbine control measures will be implemented.

The shadow flicker computer model provides very detailed information, down to the times of day when shadow flicker is predicted to occur and from which turbine for each receptor. Should it be required, this information will be used to programme shadow flicker control modules on turbines to pause turbine operation where necessary when shadow flicker is predicted to occur. Again, it is noted that the mitigation strategy outlined below is based on the theoretical precautionary scenario insofar that it discounts sunshine hours and other conditions which may naturally reduce the pre-mitigation rate of potential shadow flicker at the 6 no. properties in question. It confirms that when any required turbine control measures are deployed, these will ensure the Guideline 30 minutes per day shadow flicker is not exceeded at all houses post mitigation.

	136m Rotor Diameter Turbines		138m Rotor Diameter Turbines	
House	Predicted Pre-Mitigation Scenario (max hours per day)	Post Mitigation Scenario (max hours per day)	Predicted Pre-Mitigation Scenario (max hours per day)	Post Mitigation Scenario (max hours per day)
1	0.53	≤ 0.50	0.54	≤ 0.50
2	0.53	≤ 0.50	0.54	≤ 0.50
3	0.55	≤ 0.50	0.56	≤ 0.50
4	0.52	≤ 0.50	0.53	≤ 0.50
5	0.52	≤ 0.50	0.53	≤ 0.50
6	0.46	≤ 0.50	0.47	≤ 0.50

Table 14.10 Shadow Flicker Mitigation Strategy

It is concluded therefore that the effect of the Proposed Development will be negative, long-term and imperceptible, with the implementation of operational mitigation measures safeguarding all dwellings in the vicinity from any effects arising from shadow flicker.

PROPERTY VALUE

A study was undertaken in Scotland in 2016 examining the '*Impact of wind Turbines on House Prices in Scotland*' by Climate Exchange[7]. Based on a study of over 500,000 houses between 1990 and 2014 it found that there was no evident of a consistent negative effect of proximity to wind turbines on property value. Most results either showed no significant effect on property prices within 2km or 3km, or found the effect to be positive. While there is no equivalent Irish study, based on this it is considered that proximity to wind turbines does not impact on property prices.

14.4.4. Assessment of Effects During Decommissioning

In the Permitted Development EIS effects on population and human health during the decommissioning phase were anticipated to be of a similar nature and scale as construction effects. The Permitted Development EIS considered these to be therefore, not significant. If is considered that the amendments within the Proposed Development will not significantly alter this. Therefore, the effects are considered to be negative, slight and temporary.

14.5. Mitigation Measures and Monitoring

14.5.1. Construction Phase

The Permitted Development EIS identified that no significant mitigation was required for population and human health during the construction phase. In particular it noted that no mitigation measures were proposed in terms of the local economy as the development will have a slight positive impact on the area. However, it recommended the following measures in relation to health and safety, good construction management practice and construction traffic management.

- Both the Design and Construction phases will be managed in line with the Safety, Health and Welfare at Work (Construction) Regulations 2006 (S.I. No. 504 of 2006) and amendments. The project Safety and Health Plan will be developed in line with the regulations and the duties of the Project Supervisor Design Process (PSDP) and the Project Supervisor Construction Stage (PSCS). The site will have restricted access during construction, and will be developed by an experienced, insured contractor operating in line with a method statement and safe systems of work. It should be noted that the wind farm will be located on private land, to which members of the public have no automatic right of access until operational.
- During construction, good management practice should be applied on site to ensure dust control measures are adequate, and that stockpiled materials and roads are maintained to a high standard. The impact from construction vehicle emissions can be reduced through ensuring the quality and maintenance of vehicles and plant and through the prohibition of vehicle idling.
- The potential negative impacts associated with traffic movements during the construction phase can be mitigated through a number of measures. Local residents should be warned in advance of any large volumes of HGV traffic. Signage relating to the construction traffic routes should be agreed with Galway County Council. Turbine delivery should be agreed with Galway County Council and the Gardaí to ensure that the effect on the public is minimised.

It is considered that these measures, in addition to the specific mitigation measures included in the Noise, Air Quality and Climate Chapters, as incorporated into the CEMP (ref. Appendix 2.1), will ensure that any potential impacts are minimised.

14.5.2. Operational Phase

The regular maintenance, safety and inspections procedures as set out in the Permitted Development EIS will ensure any risks posed to human health are negligible. All mitigation as outlined under the Noise, Shadow Flicker, and Land and Soil section of this EIAR has been incorporated into the CEMP (ref. Appendix 2.1) and will be implemented in order to reduce, insofar as possible, potential adverse impacts on residential amenity at properties located in the vicinity of the Proposed Development works.

In relation to Shadow Flicker, as outlined in Section 14.4.3.6 above and in Appendix 14.1, in the event of shadow flicker exceedances, screening measures will be discussed with the affected landowner. If is it not possible to mitigate these effects with screening measures wind turbine control measures will be implemented. These measures will safeguard all dwellings in the vicinity from any effects arising from shadow flicker.

14.6. Residual Effects

14.6.1. Construction Phase

With the recommended specific mitigation measures, outlined in the Traffic and Transport, Noise, Air Quality and Climate Chapters, in place in conjunction with the health and safety, good construction management practice and construction traffic management measures, no significant residual impacts are envisaged in relation to population or human health. Overall, a neutral to negative residual effect is envisaged, of imperceptible to slight magnitude, at a local scale and of temporary to short-term duration during the construction phase of the works.

14.6.2. Operational Phase

With the recommended mitigation in place, it is considered that residual effects range from a significant, positive, long-term effect in relation to Services and Community Resources, to an imperceptible-slight, negative and long-term effect in terms of visual impact. Overall, however, with mitigation the residual effect is envisaged to be neutral, imperceptible and long-term in relation to population and human health.

14.6.3. Decommissioning Phase

With the recommended specific mitigation measures, outlined in the Traffic and Transport, Noise, Air Quality and Climate Chapters, in place in conjunction with the health and safety, good construction management practice and decommissioning traffic management measures, no significant residual impacts are envisaged in relation to population or human health. Overall, a neutral to negative residual effect is envisaged, of imperceptible to slight magnitude, at a local scale and of temporary to short-term duration during the decommissioning phase of the works.

[7] Climate Exchange is Scotland's independent centre of expertise on climate change which exists to support the Scottish Governments policy development on climate and the transition to a low carbon economy.

14.7. Cumulative Effects

14.7.1. Construction Phase

Based on a review of the potential cumulative impact projects listed in Section 1.10 it is considered that it is unlikely that any will be constructed concurrently with the Proposed Development. The adjacent Ardderroo Wind Farm, which is currently under construction is expected to be completed prior to the commencement of development of the Permitted Development and should it be permitted, the Proposed Development. Similarly, the Moycullen By-pass Road Project, which is also under construction, will be completed prior to the construction of the Proposed Development. There is a possibility that the construction of the amendment permission for 9 no turbines in the Galway Wind Park (ref. Pl. 19/1481) and the Connemara Greenway may coincide with the construction of the Proposed Development. However, the latter is of a scale and at a sufficient distance to not give rise to significant construction effects in combination with the Proposed Development. Should the construction of the former, the 9 no. permitted turbines in Galway Wind Park, coincide, construction will be managed by way of the CEMP to ensure that construction works and deliveries will be coordinated to minimise any potential impact on the population through increased construction traffic and construction noise. As noted in Chapter 1 - Table 1.3 Coillte are undertaking a felling programme in the area, with 14.8 hectares of forestry within the Ardderroo Wind Farm site earmarked for felling as part of a bog restoration plan. There is a possibility that these felling works may coincide with the construction of the Proposed Development. Should this occur, the works will be managed by way of the CEMP to ensure that the associated traffic will be coordinated.

In term of population, employment, land-use, tourism, recreational amenity and human health and residential amenity, it is not considered that any proposed developments will increase the anticipated effects of the construction stage of the Proposed Development. There is therefore no potential for cumulative construction effects in terms of population and human health arising from other projects in the vicinity.

14.7.2. Operational Phase

In terms population, employment, land-use, tourism and recreational amenity the Proposed Development is not expected to contribute to any significant, negative cumulative effects in combination with other existing and proposed developments in the vicinity. It is expected that the effects would be negative, imperceptible and long-term.

The cumulative human health consideration in relation to shadow flicker was assessed in combination with the nearby Permitted Ardderroo wind farm. The results provide that there are no residential receptors which would potentially experience in combination Shadow Flicker effects from both wind farm developments, or any other nearby wind farms (ref. Figure 14.13).

The noise assessment presented in Chapter 12 of this EIAR is inherently an assessment of cumulative wind turbine noise, as required by the IOA GPG. It envisages that the cumulative effect of the Proposed Development will not differ significantly from the cumulative effect of the Permitted Development.

There is therefore no potential for cumulative operational effects in terms of population and human health arising from other projects in the vicinity.

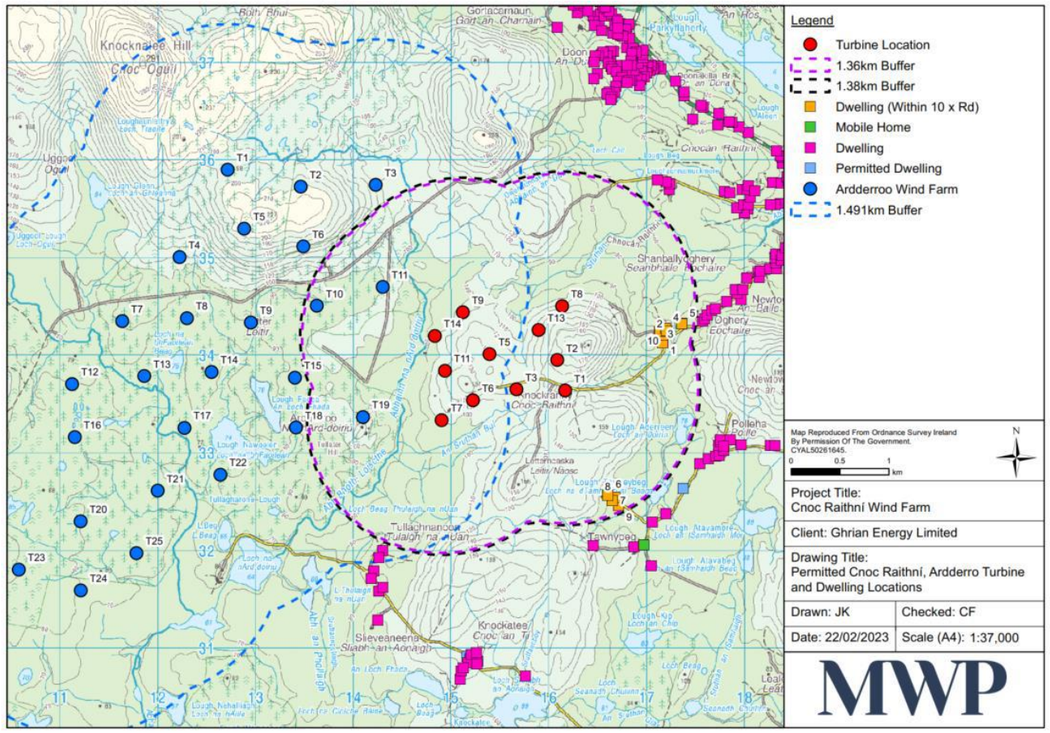

Figure 14.13 Zone of Potential Shadow Flicker Influents of Ardderroo Turbines and Varied Knockranny Turbines

14.8. Difficulties Encountered in Compiling Information

The 2022 Census detailed results were not available at the time of writing. This resulted in the sections of the demographic analysis being based on 2016 data.

14.9. References

- Central Statistics Office (CSO) Census 2011, 2016 and 2022 (preliminary) data;
- Galway County Development Plan 2022;
- Fáilte Ireland, EIAR Guidelines for the Consideration of Tourism and Tourism Related Projects;
- Failte Ireland 2008 study on "Visitor Attitudes on the Environment";
- BiGGAR Economics 2016, study on 'Wind Farms and Tourism Trends in Scotland'.

Human Health

- HSE Position Paper on Wind Turbines and Public Health (2017);

- The Institute for Environmental Management and Assessment (IEMA) UK issued a discussion document in 2017 (IEMA, 2017) on what a proportionate assessment of the impacts on health should be in EIA.
- Australian NHMRC Information Paper: Evidence on Wind Farms and Human Health 2015;
- Health Canada 2014, Wind Turbine Noise and Health Study;
- In 2012, the New South Wales (NSW) Health Department provided written advice to the NSW Government;
- Australian Medical Association, 2014, Wind farms and health.

The following websites were also consulted:

- Fáilte Ireland (www.failteireland.ie/),
- Discover Ireland (www.discoverireland.ie),
- Connemara National Park (www.nationalparks.ie/connemara),
- Coillte (www.coillte.ie/our-forests/explore/).

CNOC RAITHNÍ (KNOCKRANNY) WIND FARM

CHAPTER 15

Interaction of Impacts

VOLUME II EIAR

CHAPTER 15 – Interactions

Contents

Chapter 15

15. INTERACTION OF IMPACTS

Article 3(1) of the EIA Directive states.

> *'The environmental impact assessment shall identify, describe and assess in an appropriate manner, in the light of each individual case, the direct and indirect significant effects of a project on the following factors:*
>
> *(a) population and human health;*
>
> *(b) biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC;*
>
> *(c) land, soil, water, air and climate;*
>
> *(d) material assets, cultural heritage and the landscape;*
>
> *(e) the interaction between the factors referred to in points (a) to (d).'*
>
> *Annex IV of the amended Directive states that a description of impacts should include:*
>
> *'…the direct effects and any indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative effects of the project'.*

The preceding Chapters 4 to 14 of this EIAR identify the potential significant environmental effects that may occur as a result of the Proposed Development in terms of Landscape and Visual Impact, Material Assets – Traffic and Transportation, Material Assets – Services, Infrastructure and Utilities, Land and Soils, Water (Hydrology & Hydrogeology), Biodiversity, Ornithology, Archaeology and Cultural Heritage, Noise and Vibration, Air Quality and Climate and Population and Human Health.

The potential significant effects of these aspects are outlined in the relevant sections of this EIAR. However, all environmental factors are intrinsically linked with the potential for positive or negative interaction. This interaction between these potential significant effects could impact on the magnitude of the effect.

Figure 15.1 contains a copy of the matrix from the Permitted Development EIS which identified and assessed the potential interactions and interdependencies between the various aspects of the environment already assessed in the environmental assessment. The matrix differentiates between the occurrence of potential effects during both the construction and operation phases and between the magnitude of the interaction/impact – ranging from major to minor or neutral.

The Permitted Development EIS identified the most dynamic interactions as those between ecology, soils and hydrology, in terms of:

- Removal of soil cover impacting run-off and effecting hydrology;
- Subsequent changes in hydrology impacting on ecology.

It also identified an operational phase interaction between landscape and human beings.

This Chapter of the EIAR revisits these interactions in the context of the Proposed Development, as detailed in Chapter 2. Therefore, the assessment of interactions focusses solely on the interactions that occur specifically in relation to the Proposed Development. These are discussed in the following sections and identified in the Interaction Matrix included in Figure 15.2.

15.1. Description of Significant Interactions

15.1.1. Construction Phase

Landscape and Visual - Chapter 4 of this EIAR assesses the landscape and visual impacts on the population resultant from the construction phase of the Proposed Development to be neutral, temporary and negligible relative to the Permitted Development.

Material Assets – Traffic and Transport – Chapter 5 of this EIAR assesses the construction impact of the Proposed Development on the road network which could affect the local population and economy and concludes that the impact would be nearly identical to the Permitted Development. It is considered the effect would be temporary and not significant.

Material Assets – Services, Infrastructure & Utilities /Water – Chapter 6 of this EIAR assesses the construction phase of the Proposed Development. The main potential interaction is with the population and economy. It considers the Proposed Development will result in a temporary neutral imperceptible effect on these arising from impacts on the existing electricity supply network and water and wastewater infrastructure. The waste generated will not be of significant volumes and be of similar types to that of the Permitted Development. There is sufficient capacity at licensed disposal or recycling facilities in proximity to the Proposed Development to accommodate it. Therefore, a neutral, not significant, temporary impact on waste management facilities and therefore on the population and economic and other aspects of the environment is envisaged.

Land and Soils – Chapter 7 of this EIAR assesses the construction phase of the Proposed Development including the importation of construction materials. This could potentially impact indirectly on population and economy through increased road traffic and air quality and climate through dust and emissions. The assessment concludes that effects will be neutral, imperceptible, and short-term, with increased foundation and grid connection requirements counterbalanced by the omission of the on-site substation. No significant impact or interaction is envisaged in the removal of overburden and bedrock or the sealing of overburden material. However, potential slight to moderate negative permanent interactions with air quality, biodiversity and hydrology could occur from tree-felling and peat erosion if stored and stockpiled without appropriate mitigation, and from accidental spillage resulting in soil pollution.

Water (Hydrology & Hydrogeology - Chapter 8 of this EIAR assesses the construction phase of the Proposed Development and identifies potential interactions with biodiversity, land and soils and population and human health through surface water and groundwater contamination. It considers the potential impact of runoff from a number of sources including excavated peat, and accidental cement material, hazardous chemical or fuel spills. The construction of new infrastructure could potentially interrupt existing drainage and overland flow. In the absence of mitigation and control measures it is considered there is potential for negative slight/moderate temporary impacts to surface water quality and negative, imperceptible and long-term to surface water flows. Similarly, in the absence of mitigation any impacts on groundwater are considered to be *imperceptible adverse* and *temporary*.

Biodiversity - Chapter 9 of this EIAR assesses the construction phase of the Proposed Development and identifies potential interactions with noise, land and soils and water (hydrology and hydrogeology). Table 9-15 notes, in the absence of mitigation, that the predicted construction impact of the Proposed Development is predominantly neutral or positive, with a potential slight permanent impact anticipated on certain mammals due to tree felling buffers. However, no evidence of these mammals including badgers, red squirrel, or pine martin were recorded within the site. It anticipates a positive impact on otter due to a reduction in potential emissions to the Abhainn na nArd Doiriú watercourse and a potential short-term moderate effect on bats due to construction disturbance.

Ornithology – Chapter 10 of this EIAR assesses the construction phase of the Proposed Development and identifies potential interactions with land and soils in terms of direct habitat loss. Table 10-17 notes, in the absence of mitigation, that the predicted construction impact of the Proposed Development on the key ornithological receptors in the area is long-term and imperceptible.

Archaeology and Cultural Heritage – Chapter 11 of this EIAR assesses the construction phase of the Proposed Development and identifies potential indirect and direct interactions with landscape, land and soil and population and human health, the latter in terms of their experience of visiting cultural heritage features. The visual setting of the cultural heritage features in the vicinity could potentially be impacted by construction activity and there is potential for groundworks to impact on known and unknown archaeological features below ground. However, as there are no recorded monuments within the subject site and impacts on those within the wider EIAR Study area are envisaged to be slight to moderate. The likelihood of impacting potential unknown features along the grid connection route is considered slight. No other significant impacts are envisaged, with the exception of a moderate potential impact on the stream that forms the Ardderroo-Knockranny townland boundary and a potential not significant to slight impact on the nearby vernacular settlements.

Noise and Vibration - Chapter 12 of this EIAR assesses the construction phase of the Proposed Development and identifies potential interactions with population and human health and biodiversity. It concludes that the previous EIS for the Permitted Development fully assessed the likely significant effects of the construction of the 11-turbine layout and proposed mitigation measures to avoid or reduce these effects. The findings of the assessment with regard to the construction of the turbines and hardstands conclude that the potential effects will not be altered as a result of the Proposed Development and the proposed mitigation measures remain as set out in the Permitted Development EIS. In relation to the construction of the grid connection predicted levels of noise are well within best practice construction noise criterion therefore it is concluded that there will be no significant noise impact associated with the grid connection construction. Increased noise levels arising from the Proposed Development due to increased construction traffic are considered to be negative, slight to moderate and short-term. This remains unchanged from the Permitted Development.

Air Quality and Climate -

Chapter 13 of this EIAR assesses the construction phase of the Proposed Development and identifies potential interactions with traffic and transport, land and soils, population and human health and biodiversity. It concludes that while the construction phase will result in dust emissions, particularly during earthwork activities, due to the distance between the site boundary and the nearest properties and sensitive designated ecological receptors, any impacts arising from construction dust are considered to be imperceptible and temporary. However, notwithstanding the above a Dust Management Plan will be formulated to minimise fugitive emissions so nuisance to human health or biodiversity is envisaged. With respect to Climate, the predicted embodied emissions have been averaged over the full construction phase and the lifespan of the proposed development to give the predicted annual emissions and equate to 0.0020% of Irelands EU ESD Targets for 2030.

Population and Human Health – Chapter 14 of this EIAR assesses the construction phase of the Proposed Development and identifies potential interactions with landscape and visual assessment, noise and vibration, air quality and climate, traffic and transport.

A short-term impact is anticipated to the visual amenity of the nearby walking, hiking and cycling trails in the area as a result of construction works, include construction traffic, earthworks and erection of tall structures and other wind farm elements. However, it is noted that any increase in construction works or construction traffic arising from the alterations in the Proposed Development is not significant. Therefore, impacts arising purely from the Proposed Development on tourism and recreational amenity are considered to be negative, short-term and slight.

Impacts on the population and human health arising from the Proposed Development in terms of construction dust and construction traffic volumes are considered to be imperceptible and temporary to short-term.

15.1.2. Decommissioning

It is considered that decommissioning stage effects will not be materially different to those that have been identified for the Permitted Development. Decommissioning stage effects for all factors will be similar in nature to construction stage effects as outlined in detail in Section 15.1.1, but in reverse (dismantling of turbines) and covering a shorter duration.

15.1.3. Operational Phase

Landscape and Visual - Chapter 4 of this EIAR notes that, in general, the greatest potential for landscape impacts to occur in relation to wind energy developments is as a result of the change in character of the immediate area due to the introduction of tall structures with moving components. However, as this application represents a fractional increase in scale and intensity of an already permitted wind farm in an area already strongly characterized by the presence of wind turbines, the landscape impacts resultant from the operational phase of the Proposed Development is assessed to be low-negligible and neutral – negative.

In terms of visual impacts on the population during the operational phase, as assessed from twenty-one viewpoint locations using photomontages, the highest significance of impact of any at any of these viewpoints was deemed to be slight, at just one viewpoint, with the significance of the visual impact at the remainder considered to be slight – imperceptible (6 locations) and imperceptible (14 locations).

Material Assets – Traffic and Transport– Chapter 5 of this EIAR assesses that the operational impact of the Proposed Development on the road network which could affect the local population and economy and concludes that the impact would be nearly identical to the Permitted Development and would be imperceptible.

Material Assets – Services, Infrastructure & Utilities /Water– Chapter 6 of this EIAR assesses the operational phase of the Proposed Development will contribute directly to the electricity supply network by strengthening it through the supply of additional renewable energy. This will impact on the population and the local economy and is determined to be a positive, moderate long-term impact. It will also have a positive, indirect impacts on air quality and climate. As there are established wind farms in the vicinity it is not anticipated to have any material impact on aviation. Based on feedback from providers, with appropriate mitigation, no significant impact is anticipated on telecoms or television. No impact is predicted on water and wastewater services in the area. No significant additional waste impacts are envisaged.

Land and Soils– Chapter 7 of this EIAR assesses that no new operational phase impacts arise from the Proposed Development.

Water (Hydrology & Hydrogeology) - Chapter 8 of this EIAR assesses the operational phase of the Proposed Development and identifies potential sources of interactions with biodiversity, land and soils and population and human health through impacts on surface water quality and flow and groundwater quality and aquifer resources.

The potential risk arising from these are considered to be slight, negative and temporary and long-term respectively relating to surface water quality and flow. No impact (neutral) is envisaged on groundwater.

Biodiversity - Chapter 9 of this EIAR assesses the operational phase of the Proposed Development and identifies potential interactions with land and soils and water (hydrology and hydrogeology). Once the infrastructure is established it considers there are no likely or significant envisaged downstream aquatic receptors.

With the implementation of the proposed mitigation measures set out in Chapter 9, no significant operational effects on bats or other flora and fauna are expected.

Ornithology – Chapter 10 of this EIAR assesses the operational phase of the Proposed Development and concludes that while there is potential for interactions with water, the Proposed Development will not adversely affect the relevant European sites with the vicinity. It notes that wind energy projects have potential for interactions with land and soils resulting in impacts on Ornithological Receptors via collision, disturbance, displacement, habitat loss or damage and barrier effects. However, it concludes that the Proposed Development will not result in any changes that would affect key ornithological receptors.

Archaeology and Cultural Heritage – Chapter 11 of this EIAR assesses the operational phase of the Proposed Development and identifies potential interactions with landscape, noise, land and soil, population and human health. The visual impact on the low relict remains of the conjoined dispersed rural settlement recorded in the vicinity is classified as 'slight' to 'moderate'. No other significant effect is anticipated. With the implementation of the recommended mitigation measures, Chapter 11 considers the operation of the wind farm will provide a measure of protection for this cultural landscape.

Noise and Vibration - Chapter 12 of this EIAR assesses the operational phase of the Proposed Development, with potential interactions on population and human health and biodiversity. It compares the predicted noise levels arising from the Permitted Development with those that would arise from the Proposed Development. For both candidate turbines the difference in noise level between the Permitted Development and either proposed situation is imperceptible.

Air Quality and Climate - Chapter 13 of this EIAR assesses the operational phase of the Proposed Development and identifies potential interactions with traffic and transport and population and human health. It envisages that any impact on air quality from road traffic emissions due to the Proposed Development would be imperceptible. It considers that the supply of renewable energy to the national grid will result in a slight positive longer-term impact on air quality and human health. No additional vulnerability with respect to climate hazard is presented by the Proposed Development in comparison to the Permitted Development.

Population and Human Health – Chapter 14 of this EIAR assesses the operational phase of the Proposed Development and identifies potential interactions with landscape and visual assessment, noise and vibration and air quality and climate.

With the recommended mitigation in place, it is considered that residual effects range from a significant, positive, long-term effect in relation to Services and Community Resources, to a slight- imperceptible, negative and long-term effect in terms of visual impact, a neutral, long-term and imperceptible effect in term of noise, a slight positive longer-term impact on air quality and a negative, long-term and imperceptible effect arising from shadow flicker. Overall, however, the residual effect is envisaged to be neutral, imperceptible and long-term in relation to population and human health.

	Major Interaction/Impact
	Minor Interaction/Impact
	Neutral or No Interaction /Impact

	Human Beings		Ecology		Water		Soils and Geology		Air Quality & Climate		Noise & Vibration		Shadow Flicker		Landscape & Visual		Archaeology & Cultural Heritage		Traffic		Material Assets	
	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Human Beings																						
Ecology																						
Water																						
Soils and Geology																						
Air Quality and Climate																						
Noise and Vibration																						
Shadow Flicker																						
Landscape and Visual																						
Archaeology & Cultural Heritage																						
Traffic																						
Material Assets																						

Figure 15.1 Matrix of Impacts from Permitted Development EIS

	Major Interaction/Impact
	Minor Interaction/Impact
	Neutral or No Interaction /Impact

	Population and Human Health (inc. Shadow Flicker)		Biodiversity		Ornithology		Water (Hydrology and Hydrogeology)		Land and Soils		Air Quality and Climate		Noise and Vibration		Landscape and Visual		Archaeology & Cultural Heritage		Material Assets – Traffic and Transport-ation		Material Assets – Service, Infrastructure and Utilities	
	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Population and Human Health (inc. Shadow Flicker)																						
Biodiversity																						
Ornithology																						
Water (Hydrology and Hydrogeology)																						
Land and Soils																						
Air Quality and Climate																						
Noise and Vibration																						
Landscape and Visual																						
Archaeology & Cultural Heritage																						
Material Assets – Traffic and Transportation																						
Material Assets – Service, Infrastructure and Utilities																						

Figure 15.2 Matrix of Impacts from EIAR of Proposed Development

CNOC RAITHNÍ (KNOCKRANNY) WIND FARM

CHAPTER 16

Summary of Mitigation and Monitoring

VOLUME II EIAR

CHAPTER 16 – Summary of Mitigation Measures

Contents

Chapter 16

16. SUMMARY OF MITIGATION MEASURES

16.1. Introduction

16.1.1. Chapter Context

The 2022 EPA Guidelines regarding the information to be contained in EIAR's identifies the following strategies for the mitigation of effects.

Mitigation by Avoidance: voidance, usually referring to strategic issues – such as site selection, site configuration or selection of process technology - is generally the fastest, cheapest and most effective form of effect mitigation. In many cases mitigation by avoidance may also be considered as part of the "consideration of alternatives".

Mitigation by Prevention: This usually refers to technical measures. Where a potential exists for unacceptable significant effects to occur (such as noise or emissions) then measures are put in place to limit the source of effects to a permissible and acceptable level.

Mitigation by Reduction: This is a very common strategy for dealing with effects which cannot be avoided. It tends to concentrate on the emissions and effects and seeks to limit the exposure of the receptor. This is regarded as a less sustainable, though still effective, approach. Strategies utilised are 'Reducing the Effect' or 'Reducing the Exposure to the Effects'/

Offsetting: This is a strategy used for dealing with adverse effects which cannot be avoided. It includes measures to compensate for adverse effects. Examples include restoration of buildings, walls or features to compensate for loss of similar features, planting of new vegetation elsewhere to replace unavoidable loss of similar vegetation and Provision of a new amenity area to replace amenity lost as a result of a project.

16.1.2. Decommissioning Stage - Mitigation Measures

Decommissioning stage effects will be similar in nature to construction stage effects, but in reverse (dismantling of turbines) and covering a shorter duration. It is considered that decommissioning stage mitigation measures will not be materially different to those set out below in relation to construction mitigation measures. In the interest of avoiding duplication, it is assumed that decommissioning mitigation measures will be the same as the construction mitigation measures, unless specifically included below.

16.2. Mitigation Measures Proposed

16.2.1. Landscape and Visual (Chapter 4)

16.2.1.1. Design Stage - Mitigation Measures

As outlined in Chapter 3, as part of Western Power Developments Limited's technical review of the permitted wind farm, consideration was given to potentially redesigning the permitted wind farm turbine layout and increasing the turbine heights further than that proposed. Following a review of the permitted turbine layout; the Applicant has resolved to minimise the potential for any increased environmental effects by maintaining the same number of turbines in an unchanged turbine layout configuration from the Permitted Development. While the turbine number and locations are being maintained, the proposed tip height of up to 140.5m has been reconsidered having regard to turbine technology developments since the original layout design in 2013, with a standard tip height of 150m now being proposed. The proposed change in turbines will necessitate some revisions to the size of supporting foundations. However, while in the original permitted layout, 6 no. turbines had a hub height of 90m and 5 no. turbines had a hub height of 80m, it is now proposed that all turbines will have a hub height of 81m or 82m depending on the chosen option of the two candidate turbines assessed in this EIAR. The reduced visual impact resulting from the proposed reduction in hub height of the majority of turbines will contribute towards balancing any increased visual impact arising from the increased tip-height.

16.2.1.2. Construction Stage - Mitigation Measures

As the Proposed Development relates to alterations to the Permitted Development, the construction impacts will be very similar. The Proposed Development consists of very minor changes in the context of physical land disturbance in this already modified forestry and wind farm setting. Overall, the magnitude of landscape impacts during construction are deemed Negligible and the quality of the effect will be Neutral. In this context no specific landscape and visual related mitigation measure, in addition to those of the Permitted Development, are considered necessary during the construction stage.

16.2.1.3. Operation Stage - Mitigation Measures

Chapter 4 notes that there will be a fractional increase in the scale and intensity of the development due to the larger rotor diameters and slightly increased tip heights of the turbines. However, there remains the same number of commercial scale turbines within a landscape already defined by wind energy development and other extensive land uses such as forestry and upland farming. In this context the magnitude of operational stage landscape impact is Low-negligible and marginally negative i.e., Neutral-Negative. Therefore, no specific landscape and visual related mitigation measure, in addition to those of the Permitted Development, are considered necessary during the operational stage.

16.2.2. Material Assets – Traffic and Transportation (Chapter 5)

16.2.2.1. Construction Stage - Mitigation Measures

Chapter 5 concludes that the additional HGV traffic, during the peak construction period, would have no effect on the capacity of the road network in the long term. The Applicant will continue to meet residents throughout

the construction process so that issues can be raised, and where possible, the Applicant will adjust working practices to benefit the local community while minimising traffic disruption on the local road networks by ensuring all HGVs follow the designated haulage route.

The following mitigation measures will be implemented to ensure a safe and regulated traffic management system is enforced.

- Ensure a strict protocol for HGV drivers to follow the designated haulage route and timing restrictions regarding commuting traffic, as detailed;
- Advance warning should be given to the local residents and other users (i.e., cyclists) for specific times when large volumes of HGV traffic may occur;
- All signages relating to the proposed construction traffic routes for construction traffic to be agreed with the Galway County Council;
- A maximum speed limit would be imposed for HGVs on the local road network during the construction phase, in particular through Oughterard and Moycullen;
- A maximum speed limit of 20 km/hr would be imposed on the L-53453 and the internal site track roads;
- A well planned and executed delivery programme avoiding peak traffic on typical days would be ensured (i.e., local school start and finish times);
- Adequate parking would be provided on site for both employees and visitors to ensure parking would not occur on the public road;
- A road sweeping vehicle would be provided as required to remove any mud that is deposited on the N59 and L-53454;
- The condition of the N59 and L-53454 would be monitored on an on-going basis;
- Enforcement of existing regulatory markings and signages would be ensured; and
- Car pooling arrangements for regular employees.

Road Repairs

Pre-construction and post-construction surveys will be carried out to ensure the structural integrity of the proposed haulage route road network. If necessary, road repairs will be carried out on the public roads during the construction phase to ensure that the road condition does not deteriorate below a standard that could affect the use of the Site and public. Following completion of construction, the condition of public road will be of at least the same standard as it was prior to commencement of construction.

Traffic Management Plan

Prior to commencement a Traffic Management Plan will be prepared following consultation with the Roads Department of Galway County Council. Construction activities associated with the Proposed Development will adopt working practices to ensure the safety and convenience of all road users (i.e. pedestrians, cyclists, drivers, etc.), during the construction of the development, as detailed in Chapter 5.

To further minimize the traffic impacts to public, a Traffic Management Plan will be prepared in consultation and agreement with the relevant project developers to minimize peak construction traffic flows, in particular HGV traffic associated with concrete pouring for turbine foundations.

16.2.2.2. Operation Stage - Mitigation Measures

It is envisaged that the Proposed Development will not generate any adverse impacts on traffic in the vicinity of the subject site on a long-term basis, once the wind farm is in operation. Therefore, no mitigation measures, in addition to those of the Permitted Development, would be required for the operational phase under the Proposed Development.

16.2.2.3. Decommissioning Stage - Mitigation Measures

All infrastructure including turbine components will be separated and removed off-site for re-use, recycling and waste disposal. A Project Decommissioning Plan has been prepared and included within the Project CEMP (ref. CEMP Appendix 2.1). However, it is envisaged that the Proposed Development will not generate any additional impacts on the traffic in the vicinity of the subject site than that identified for decommissioning of the Permitted Development. Therefore, no mitigation measures, in addition to those of the Permitted Development, would be required for the decommissioning phase under the Proposed Development.

16.2.3. Material Assets – Services, Infrastructure and Utilities (Chapter 6)

16.2.3.1. Design Stage - Mitigation Measures

Chapter 6 of this EIAR sets out the following mitigation measures which are designed to protect the existing utilities and ensure minimum to no disruption to the existing services:

Electricity Supply and Infrastructure

Mitigation by design has been adopted whereby the grid connection methodology has been selected to ensure no significant effects on existing electrical infrastructure.

Prior to construction confirmatory drawings for all existing services will be sought upon consultation with ESB Networks and other stakeholders.

16.2.3.2. Construction Stage - Mitigation Measures

Electricity Supply and Infrastructure

Immediately prior to construction taking place, the area where excavation is planned will be re-surveyed by CAT scan (sub-surface survey technique to locate any belowground utilities) and all existing services will be verified. Temporary warning signs will be erected.

Clear and visible temporary safety signage will be erected all around the perimeter of the live work area to visibly warn members of the public of the hazards of ongoing construction works.

The as-built location of the installed ducts will be surveyed and recorded using a total station/GPS before the trench is backfilled to record the exact location of the ducts. The co-ordinates will be plotted on as-built record drawings for the Proposed Development operational phase.

Aviation

Chapter 6 considers that no impacts to aviation are likely during the construction phase. No mitigation is therefore required.

Television and Telecommunications

It also envisages that no impacts to television and telecommunications are likely during the construction phase. Therefore, no mitigation is required.

Water Supply and Wastewater Infrastructure

Chapter 6 states that wastewater that will be generated during the construction phase will be managed by the installation of a temporary integrated waste holding tank. All wastewater to be taken off-site, by an authorised waste contractor and brought to an authorised waste facility.

Waste Management

Waste will be managed in accordance with the waste hierarchy in Council Directive 98/2008/EC on waste and section 21A of the Waste Management Act 1996, as amended, as follows:

(a) Prevention; (b) re-use; (c) Recycling; (d) Other recovery (including energy recovery); and (e) Disposal.

Waste generation is principally avoided through planning and management of activities and good housekeeping. The procurement of material inputs is generally in bulk. By bulk procurement, the generation of small-sized containers and packaging is largely avoided and thus minimises the generation of unnecessary waste requiring recycling or disposal.

In line with the Waste Hierarchy, wherever possible, packaging will be returned to originator. All waste for offsite treatment/disposal is to be stored temporarily in appropriate dedicated storage areas. The areas in which wastes are stored on site are segregated to prevent material and contaminated surface water runoff entering local surface water drains.

All chemical, hydrocarbon or other controlled wastes will be stored in designated areas in appropriate approved containers within bunds or on spill pallets, as required.

All waste to be removed from site will be undertaken by authorised waste contractors and transported to an authorised facility in accordance with best practice and the site waste management plan as discussed in the CEMP (EIAR Volume III - Appendix 2-1).

16.2.3.3. Operation Stage - Mitigation Measures

Electricity Supply and Infrastructure

There is no anticipated effect upon the grid network outside of the infrastructure for the Proposed Development itself. The Proposed Development will provide a positive effect on the electricity supply infrastructure. No specific mitigation measures are proposed.

Aviation

Whilst the Proposed Development will not impede aircraft, IAA Electronic Air Navigation Obstacle Data sets have identified obstacles as objects whose height above ground level is 90m or higher, affecting air navigation. Irish Wind Energy Association (IWEA) Guidelines have set out the following measures to ensure that pilots of aircraft are fully aware of the presence of wind turbines:

- All turbines and meteorological masts having a height of 90m or more are promulgated in the Irish Air Navigation Obstacle database;
- Wind turbines or any structure exceeding 90m in height may require appropriate aviation warning lighting as agreed with IAA;
- The IAA should be informed 30 days in advance of the erection of any structure exceeding 45m in height.

Having regard to the above:

- The Applicant will agree an aeronautical obstacle warning light scheme for the wind farm development with the IAA;
- The Applicant will provide the IAA with as-constructed coordinates in WGS84 format together with ground and tip height elevations at each wind turbine location;
- The Applicant will notify the IAA of intention to commence crane operations with a minimum of 30 days prior notification of turbine erection.

Television and Telecommunications

In the event of interference to television and telecommunication services arising from the Proposed Development the Applicant is committed to work with telecommunication providers to remedy any issues of interference to affected communication links. If required, appropriate mitigation measures can be implemented such that there will either be an imperceptible effect, or no effect, on surrounding reception as a result of the Proposed Development, with the solution to interference with TV reception or communication links dependent on where the residence receives signal from.

As standard practice, a signed Protocol between the Applicant and 2rn will be put in place, in which the Applicant will be responsible to resolve any issue of interference with television reception as a result of the Proposed Development.

Water Supply and Wastewater Infrastructure

Chapter 6 concludes that no mitigation is required for Water Supply and Wastewater Infrastructure as part of the Proposed Development.

Waste Management

All waste for offsite treatment/disposal is to be stored temporarily in appropriate dedicated storage areas. The areas in which wastes are stored on site will be segregated to prevent material and contaminated surface water runoff entering local surface water drains.

All chemical, hydrocarbon or other controlled wastes will be stored in designated areas in appropriate approved containers within bunds or on spill pallets, as required.

All waste to be removed from site will be undertaken by authorised waste contractors and transported to an authorised facility.

16.2.3.4. Decommissioning Stage - Mitigation Measures

Mitigation measures proposed during the construction phase will also be implemented during the decommissioning phase. As no additional significant effects are assessed as likely to occur during the decommissioning phase no specific mitigation measures are proposed or required. All tall structures will be removed, and no significant effects are assessed as likely on telecommunications, television or aviation. The approach to decommissioning will be confirmed based on best practice at the time. A decommissioning plan will be agreed with Galway County Council three months prior to decommissioning the Proposed Development. A decommissioning plan is contained in the CEMP in Volume III - Appendix 2.1. Decommissioning phase effects are assessed to be similar to those of the construction phase but of a reduced scale and magnitude. Consequently, it is assessed that the decommissioning phase will not give rise to any likely significant effects.

16.2.4. Lands and Soils (Chapter 7)

As the Proposed Development relates to amendments to the Permitted Development, some of the mitigation measures identified below relate to the Project rather than being specifically related to the Proposed Development. However, they have been included here for completeness.

16.2.4.1. Design Stage - Mitigation Measures

Mitigation measures implemented during the design phase include:

- Placement of turbines and associated infrastructure in areas with shallow peat during the design phase;
- Use of the existing road network to reduce peat excavation;
- No turbines or related infrastructure will be constructed near or on any designated sites such as NHAs or SACs.

16.2.4.2. Construction Stage - Mitigation Measures

Mitigation measures for the construction phase include:

- The peat and subsoil which will be removed during the construction phase will be localised to the Proposed Development infrastructure;

Erosion, Storage & Stockpiles

Mitigation measures for the erosion, storage and stockpiles include:

Peat removed from turbine locations and access roads will be used for landscaping, where it can be placed alongside internal access roads or in the peat deposition area. Where possible, the acrotelm shall be stored with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation at the surface of the stored peat within the peat deposition area. Reseeding and spreading/planting of heather and moss cuttings will also be carried out in these areas. These measures will prevent erosion of stored peat in the long term.

Any excess temporary mounded peat in storage for long periods will be sealed using the back of an excavator bucket. This will prevent erosion of soil. Silt fences will be installed around stockpiles to limit movement of entrained sediment in surface water runoff. The use of bunds around earthworks and mounds will prevent egress of water from the works.

In order to minimize erosion of mineral subsoils stripping of peat will not take place during extremely wet periods as defined in the Chapter 8 of this EIAR (to prevent increased silt rich runoff). Temporary drainage systems will be required to limit runoff impacts during the construction phase.

During tree felling, brash mats will be used to support vehicles on soft ground, reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place when they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. All felling and brashing will be undertaken in adherence of the relevant policies and guidelines for forestry felling as set out in the CEMP (re. Appendix 2.1).

Soil Pollution

Mitigation measures for soil pollution include:

- Minimal refueling or maintenance of construction vehicles or plant will take place on site. Off-site refueling will occur at a controlled fueling station;
- On site re-fueling will be undertaken using a double skinned bowser with spill kits on the ready for accidental leakages or spillages;
- On site re-fueling will be undertaken by suitably trained personnel only under a permit to refuel system;
- Fuels stored on site will be minimised. Storage areas located at the temporary compound where required will be bunded appropriately for the fuel storage volume for the time period of the construction and fitted with a storm drainage system and an appropriate oil interceptor;
- The electrical substation extension will be bunded appropriately to the volume of oils likely to be stored, and to prevent leakage of any associated chemicals and to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose;
- An emergency plan for the construction phase to deal with accidental spillages is contained within the Construction and Environmental Management Plan; and
- Spill kits will be available to deal with accidental spillage in and outside the re-fueling area.

Peat instability and failure

Based on the recommendations and control measures given in the geotechnical and peat stability assessment report (JBB, 2023) being strictly adhered to during construction and the detailed stability assessment carried out for the peat slopes which showed that the site has an acceptable margin of safety, there is a low risk of peat instability/failure at the Proposed Development site.

The risk assessment at each turbine location identified a number of control measures to reduce further the potential risk of peat failure. Access roads to turbines will be subject to the same relevant control measures that apply to the nearest turbine as detailed in the geotechnical and peat stability assessment report (JBB, 2023).

The following measures which will be implemented during the construction phase of the project will assist in the management of the risks for this site.

- Appointment of experienced and competent contractors;
- The site will be supervised by experienced and qualified personnel;
- Allocate sufficient time for the project (be aware that decreasing the construction time has the potential to increase the risk of initiating a peat movement);
- Prevent undercutting of slopes and unsupported excavations;
- Maintain a managed robust drainage system;
- Prevent placement of loads/overburden on marginal ground as detailed in the peat stability assessment report;
- Set up, maintain and report findings from monitoring systems;
- Ensure construction method statements are followed or where agreed modified/developed; and,
- Revise and amend the Geotechnical Risk Register as construction progresses.

Please refer to the geotechnical and peat stability assessment report (JBB, 2023) for proposed turbine specific and road section mitigation measures.

16.2.4.3. Operation Stage - Mitigation Measures

It is envisaged that the Proposed Development will not generate any adverse impacts on land and soil in the vicinity of the subject site on a long-term basis, once the wind farm is in operation. Therefore, no mitigation measures, in addition to those of the Permitted Development, would be required for the operational phase under the Proposed Development.

16.2.5. Water (Chapter 8)

16.2.5.1. Design Stage - Mitigation Measures

In Chapter 8 it states that mitigation has been embedded in the design considerations (see below), and the potential impact of the Proposed Project as designed has been assessed.

The underground electrical and communications cabling route to the Ardderroo substation crosses a small culverted 1st order tributary of the Abhainn na nArd Doiriú at two locations. In one case, the crossing has been designed to ensure that the cabling passes over the culvert within the makeup of the existing road. There will be no direct impact on the stream. In the second case, the culvert will be extended with the cabling passing over it in access track. These works will be undertaken in accordance with a detailed method statement which mitigates the potential for any environmental effects, as detailed in the CEMP.

16.2.5.2. Construction Stage - Mitigation Measures

The construction contracts will require that the contractor at construction stage produce a contract specific Construction Environmental Management Plan (CEMP). The specific measures identified as minimum requirements to be included in a CEMP to ensure any impacts are limited, are summarised in the following subsections.

Construction Environmental Management Plan (CEMP).

A CEMP has been prepared and is enclosed in Appendix 2.1. The CEMP will ensure that any impacts are limited, and mitigation measures are summarised in the following subsections. An Environmental Clerk of Works (ECoW) with appropriate experience and expertise will be employed for the duration of the construction phase to ensure that all the environmental mitigation measures outlined in relation to the environment are implemented. This ECoW will be awarded a level of authority and will be allowed to stop construction activity if there is potential for adverse environmental effects to occur. The contractor's CEMP will adopt the requirements of this CEMP and include any additional requirements arising from any decision to grant permission for the Proposed Development.

Hydrological Construction Phase

- All temporary construction compounds, storage areas will be located >50 m from any water course.
- Immediate removal/disposal of surplus material off-site will be implemented.
- Drainage within soil bunds will be provided to reduce the influence upon the surface runoff pathways of flood water.
- Direct discharge of surface water from any temporary impervious area to the nearby watercourse without proper attenuation will be avoided;
- Construction will follow current standard and regulated practices to minimise sediment transport. Perimeter erosion and sediment control measures will be installed around the entire wind farm development footprint. This will include upslope clean water interception channels, down-slope dirty water collection channels, and construction of temporary sediment traps where required.
- Pollution control measures for concrete pouring to include effective containment will be implemented. Dedicated concrete cute washout area to be provided.
- During the construction phase, an integrated waste holding tank will be used on site for toilet facilities. This will be maintained by the service contractor on a regular basis and will be removed from the site on completion of the construction phase.
- Temporary attenuation ponds will be provided if the stream to which surface water from the construction area is discharged has limited capacity.
- The surface water runoff at the construction sites will be managed to prevent flow of silt-laden surface water flowing into adjoining surface watercourses. To achieve this, the appointed contractor(s) must comply with the CIRIA publication *Control of water pollution from linear construction projects. Technical Guidance (C648)* (CIRIA 2006).
- Construction will follow current standard and regulated practices to minimise sediment transport. Perimeter erosion and sediment control measures will be installed around the entire wind farm development footprint. This will include upslope clean water interception channels, down-slope dirty water collection channels, and construction of temporary sediment traps where required.
- All works in or adjacent to watercourses will comply with EPA, Inland Fisheries Ireland and OPW requirements.
- All tree felling will be undertaken using Forest Service good working practices to reduce the risk of entrainment of suspended solids and nutrient release, inclusive of hand felling, use of prescribed aquatic buffer zones, timber stacking outside buffer zones and the undertaking of works in periods of no or low rainfall.
- A water quality monitoring programme will set up prior to construction works and implemented to the agreement of Inland Fisheries Ireland, to include laboratory analysis, water quality monitoring instrumentation and visual inspections.
- On-site fuel storage and refueling of plant and vehicles will be undertaken on impermeable and bunded areas and away from any rivers or other watercourses. Adequate means to absorb or contain any spillages are available at all times.
- The appointed contractor(s) will inspect and monitor the water quality of surface waters near any works, particularly in relation to increased silt levels. This monitoring process will form part of the Environmental Management Plan for the Construction Phase.

Hydrogeology Construction Phase

The only mitigation is adherence to best practice operating procedures related to sediment and erosion controls as specified above and detailed in the CEMP.

16.2.5.3. Operation Stage - Mitigation Measures

Hydrology Operational Phase

To prevent or reduce impacts on watercourses, Wastewater management during the operational phase will be facilitated by an existing holding tank at the Ardderroo Substation, the tank will be maintained by a licenced waste contractor that will be regularly empty it to a licensed wastewater treatment plant.

The additional foundation footprint will be reinstated with landscaping/ peat to the hardstanding generated by the Permitted Development.

Following on from the establishment of the water quality monitoring programme for the construction phase, regular water quality audits should be undertaken for the first 6 months of the operational development.

Hydrogeology Operational Phase

The only mitigation is adherence to best practice operating procedures including maintenance of drainage will be required during the operational phase as detailed in the CEMP.

16.2.6. Biodiversity (Chapter 9)

16.2.6.1. Construction Stage - Mitigation Measures

The EIS for the Permitted Development fully assessed the likely significant effects of the 11 no. turbine layout and proposed mitigation measures to avoid or reduce these effects. The findings of the assessment and proposed mitigation measures within the EIS for the Permitted Development will not be altered as a result of the Proposed Development. Chapter 9 recommends the inclusion of the following further mitigation measures:

Aquatic Ecology

All construction phase environmental controls, mitigations and conditions in the area of surface water protection will be implemented as set out in the existing consent. This relates specifically to controls on sources and pathways of potential sediment, concrete, and hydrocarbon loss from the wind farm and proposed underground cabling route during the construction phase and includes all controls on potential forestry felling related nutrient and sediment losses, as permitted.

Compared to that already permitted, the Proposed Development, the additional cable laying required to connect to Ardderroo substation does not present likely significant effects on any identified aquatic receptors, but as a precautionary measure and to address any potential for cumulative impacts, specific mitigations are set out in Table 16.1 (based on Table 9-29), primarily in relation to prevention and/or control of potential sediment loss during construction.

Table 16.1 Additional Grid Connection Cabling Route – Construction Mitigation

Objective	Measure	Details of Mitigation
Prevention and control of sediment loss	Best Management Practice – Cable Trenching	All trenching works shall be undertaken using a procedure ensuring that only short sections of the trench (≤100m) are open at any time, with each section capable of being cut and refilled within a single workday to prevent unexpected rainfall causing wash-out. Any run-off water which gathers in an excavated trench must be collected and treated appropriately using Best Practice methods (e.g., silt bags, settlement systems) before being discharged. There will be no discharge of silt contaminated pump-out water directly to on-site drains. Freshly excavated spoil must be retained in an area over 10m away from any drain or watercourse until such time as the trench is refilled. Where ancillary onsite drains are crossed with underground ducting, the release of sediment over baseline conditions will be prevented using silt traps, check dams and/or bunds. These will be put in place on either side of the dry drain crossing location in advance of construction works.
Prevention and control of sediment loss	Best Management Practice – Drain crossing	Drains are currently piped beneath the existing access roads that form the proposed grid connection cabling route. The 6 no. existing drains will be clearly marked with stakes or paint. Trenching will proceed to either side and then beneath the existing pipe(s) without disturbance to the drainage water flow through them. Where pipe extensions are required, these shall be pre-installed to carry any drain flow over the construction area, creating a dry working area Preferential flow pathways from the trench and/or road surface towards the entry or exit of each piped drain shall be temporarily blocked using sand bags or staked geotextile silt fencing whilst the works are occurring and removed once the road widening and trenching is complete and stabilised.
Prevention and control of sediment loss	Best Management Practice – Culvert extension	The piped culvert extension and cable ducting on the unnamed Abhainn na nArd Doiriú tributary will be installed during a low flow period. The instream works area will be made dry using a temporary pipe extension that carries drain flow over the entire works area. The permanent extension will be laid at the same gradient as the existing culvert and shall be embedded at the downstream end a minimum of 30cm with appropriate scour protection, if necessary, in the form of cobble/gravel substates.
Prevention and control of sediment loss	Best Management Practice – Forestry Felling	The following Guidelines & Standards apply during felling operations: ▪ Forestry & Water Quality Guidelines (DAFM, 2000a) ▪ Forest Harvesting & the Environment Guidelines (DAFM, 2000b) ▪ Standards for Felling and Reafforestation (DAFM, 2019) The ECoW will ensure all felling related water quality protection guidelines and standards are complied with during the pre-commencement and felling phases. The ECoW will carry out daily visual checks of all measures employed to avoid or reduce impact of forestry residues, erosion, including inspections of temporary drainage infrastructure (e.g., drain crossings), silt control measures, extraction routes and log storage areas. A detailed and comprehensive pre-felling survey of the minor drainage channels within the proposed felling areas and their proposed access routes must be undertaken by the forestry harvesting Site Manager and the ECoW. This will identify all 'aquatic zones' and 'relevant watercourses' / drains (as specified in Felling Standards (DAFM (2019)). Areas of very wet ground ("hotspots") must also be marked as exclusion

Objective	Measure	Details of Mitigation
		zones as these could become damaged by machine tracking and/or become preferential surface run-off conduits following the felling. Water exclusion zones (Section 6.1 DAFM (2019)): Before operations commence, identify a 10 m wide exclusion zone along the edge of aquatic zones and hotspots, and mark this clearly on a site map. Machine traffic and timber stacking are not permitted within these zones. Trees within the reach of the harvester arm should be felled by harvester and stacked 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 processing outside the exclusion zone. In all cases, fell trees away from a water feature. Remove brash from drains and in as much as possible from the felling site as per the original wind farm consent. Silt & sediment control (Section 7 DAFM (2019)): Prior to the commencement of operations, install silt traps within existing forest drains that connect with aquatic zones, either directly or indirect through other relevant watercourses. Silt traps should be staggered along the length of the drain, and not only at the lower reaches towards its outflow. Apply silt fences where necessary, to block pathway for silt in areas where overland flow is possible. Once silt traps and silt fences become functional, check regularly and maintain as necessary, in order to ensure continued effectiveness throughout operations. Temporary water crossings (Section 8 DAFM (2019)): Avoid crossing on-site forest drains / 'relevant watercourses' and aquatic zones. Direct crossing over stream beds is not permitted. Minimise the crossing of drains during felling and extraction and restrict machine activity to brashed extraction racks and haulage routes. Where a drain crossing is needed, select a method that prevents the breakdown and erosion of drain sides. Where necessary, deploy a heavy-duty plastic culvert lengthways into the channel and cover with brash material. The culvert must be correctly sized and overlaid with brash.

Objective	Measure	Details of Mitigation
Overseeing of environmental controls	Monitoring during Construction	A suitably qualified Ecological Clerk of Works (ECoW) will be employed to oversee the construction phase, including any advance works period, to ensure compliance with methods, mitigation measures and monitoring set out in the existing consent, the Construction and Environmental Management Plan (CEMP) accompanying this application and this document.

Amphibians

Spawning habitat for common frog was recorded in ditches present to the south of the road servicing Ardderroo substation and alongside the forestry road at the location of the proposed underground cabling. Frogs are active from spring to autumn. If works to clear any of the habitat features suitable to support common frog are to begin during the season where frogspawn or tadpoles may be present (February – mid-summer), a pre-construction survey will be undertaken to determine whether breeding common frog are present. Any frog spawn, tadpoles, juvenile or adult frogs present will be captured and removed from affected habitat by hand net and translocated to the nearest area of available suitable habitat.

If the size or depth of the habitat feature is such that it cannot be determined whether all common frogs have been captured, it will be drained under the supervision of a suitably experienced ecologist to confirm that no amphibian species remain before it is destroyed or infilled. Any mechanical pumps used to drain the habitat feature will have a screen fitted and be sited so that no amphibian species can be sucked into the pump mechanism.

Any capture and translocation works shall be undertaken immediately in advance of site clearance/construction works commencing.

Mammals

A pre-construction mammal survey will be undertaken for otter and badger within suitable habitats within the works areas associated with the Proposed Development site. The survey will be undertaken to check for any changes in otter and badger and to ensure that these species have not taken up residence within or close to the development footprint.

Bats

Buffer Zone

To minimize risk to bat populations during forestry clearance, a buffer zone is required around any treeline, hedgerow, woodland feature, into which no part of the turbine should intrude.

According to Nature Scot (2021) guidance:

> *"The Eurobats guidance recommends a 200m buffer around woodland areas. There is, however, currently no scientific evidence to support this distance in the UK and it is recommended that a distance of 50m between turbine blade tip and nearest woodland (or other key habitat features such as wetlands etc.) is adequate mitigation in most, lower risk situations. Exceptionally, larger buffers may be appropriate, e.g. near major swarming and hibernation sites. The longevity of wind farms should also be taken into account and the maximum growth, or management, of woodland and other relevant habitat features considered in their planning."*

These distances were taken into account during the design phase of the Proposed Development. The formula illustrated in Figure 16.1 (based on Figure 9-7) was used to calculate the required felling buffer for each turbine. A felling buffer is required for conifer plantation located in the vicinity of turbines T1, T3, T9 and T14.

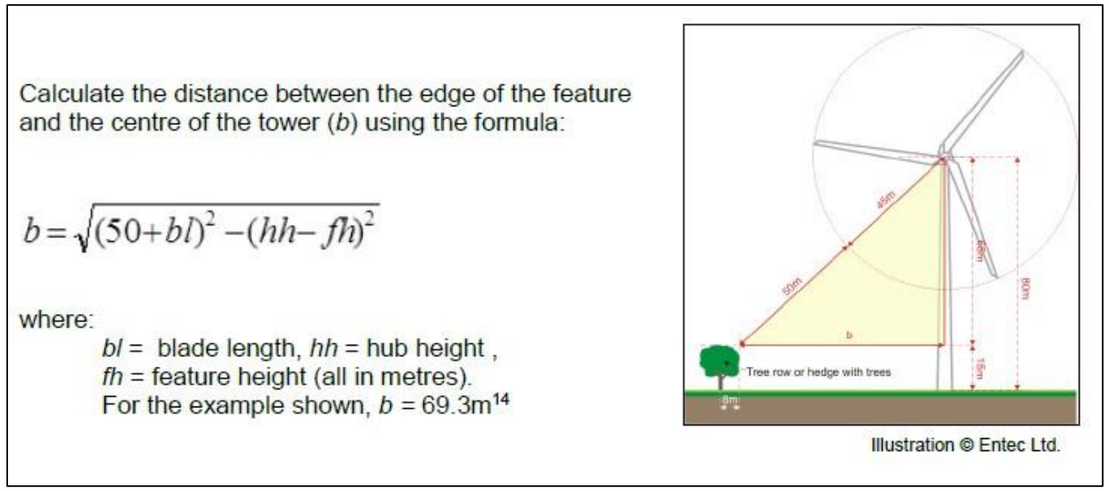

Figure 16.1 Estimating Buffer Distance (Nature Scot, 2021)

Existing trees will be cleared around turbines T1, T3, T9 and T14 to provide a vegetation-free buffer zone around each turbine. All buffers will be maintained throughout the lifetime of the wind farm. The replacement planting that will be needed off-site to offset the felling on-site will be subject to FS Licence and will be carried out outside the Water Catchments where the Proposed Development is located.

In addition to the above mitigation by design, the following mitigation measures are proposed:

Lighting restrictions

In general, artificial light creates a barrier to bats so lighting should be avoided where possible. 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 construction lighting is required, lighting shall be directed away from all woodland and linear habitats to be retained. This can be achieved by the design of the luminaire and by using accessories such as hoods, cowls, louvers and shields to direct the light to the intended area only.

Ecological Restoration and Enhancement Management Plan

The Ecological Restoration and Enhancement Management Plan for the Permitted Development includes for the enhancement of keyhole felled areas. As stated in Section 3.2.7.2 of the Ecological Restoration and Enhancement Management Plan "*native broadleaved trees will be planted a minimum of 50m away from turbines to maintain the protective bat buffer*". This requirement will be amended to exclude the planting of tree and scrub species within the felling buffer as defined in Figure 16.1 (based on Figure 9-7).

Pre-construction Surveys

If two years lapse between the completion of bat activity surveys within the study area and commencement of construction, it will be necessary to repeat one season of surveys during the activity period. Future survey work will be completed according to best practice guidelines available (Collins, 2016; Nature Scot 2021 and any updates of these guidelines) and will include static detector, activity and roost inspection surveys. The results of these surveys will be used to refine mitigation measures as appropriate.

16.2.6.2. Operation Stage - Mitigation Measures

Aquatic Ecology

All operation phase mitigations and conditions will be implemented as set out in the existing consent. This relates specifically to environmental controls on sources and pathways of potential sediment, concrete and hydrocarbon loss from the Proposed Development during the operation phase.

Bats

As detailed in Section 9.5.1.4, a buffer zone free of woodland/trees within 50m of turbine blade tips will be created during the construction phase. This requirement will mitigate potential impacts as a result of collision mortality during the operational phase.

Monitoring

A Bat Monitoring Plan will be prepared in accordance with Nature Scot (2021) guidelines. The aim of the monitoring will be to assess changes in bat activity patterns and the efficacy of mitigation. Monitoring should take place for at least 3 years after construction and shall include static detectors surveys, walked survey transects and corpse searching. A curtailment programme will be devised at end of Year 1, if necessary, around key activity periods / weather parameters. Effectiveness of mitigation / curtailment should be monitored and kept under review for 3 year period.

16.2.7. Ornithology (Chapter 10)

16.2.7.1. Construction Stage - Mitigation Measures

Chapter 10 sets out that all construction phase mitigation for avifauna will be implemented as set out in the EIS for the Permitted Development to include:

- Implementation of a Red Grouse Management Plan, including the requirement for an ecological officer (also referred to as an Ecological Clerk of Works) to monitor construction phase;
- The felling of conifers should take place outside the breeding bird season, if possible;
- Implementation of habitat restoration measures to offset any habitat loss;
- Minimizing damage or loss of wet heath/ blanket bog habitats during construction phase through demarcation of site and restriction of access outside of this. Machinery to be kept on roads and hardstanding areas.
- Agreed bird monitoring programme to be implemented to include vantage point surveys, Red Grouse survey and breeding bird transects.

The Proposed Development does not present likely significant effects on ornithological receptors. No further specific mitigation measures are required.

16.2.7.2. Operation Stage - Mitigation Measures

It also states that all operational phase mitigation and monitoring for avifauna will be implemented as set out in the EIS for the Permitted Development to monitor any residual unpredicted impacts on birds, as well as the effectiveness of the mitigation measures.

16.2.8. Archaeology & Cultural Heritage (Chapter 11)

16.2.8.1. Construction Stage - Mitigation Measures

Chapter 11 sets out the following mitigation measures:

- During the construction phase all works involving topsoil removal, specifically the turbine foundation platforms and, the access roads and undisturbed ground of proposed grid connection, should be monitored by a suitably qualified and experienced archaeologist under licence issue by the National Monuments Service (NMS). Particular attention should be paid to all proposed ground works and topsoil removal in proximity to Turbine 6 as the precise location of the recorded children's burial ground (CBG) (GA067-033) is not precisely known. In that context, it is imperative that all works here should be carried out under close archaeological supervision.
- An exclusion zone (reflecting the RMP's zone and zone of notification combined) around the possible CBG (GA067-033) should be physically established and clearly visible / recognizable on the ground by an archaeologist prior to construction stage.
- Should archaeological remains be discovered, other archaeological work may be required by the NMS following submission of an assessment of the extent and nature of the revealed archaeology. In that context, the monitoring archaeologist will need to be facilitated by the contractor in having groundworks temporarily halted in order to ascertain, report and protect the archaeology until such time as an inclusive response is received from the NMS.
- Any potential stone removal in the vicinity of Cloghvally vernacular settlement must be undertaken under archaeological supervision.
- Any potential stone removal of the relict remains of the single house and associated walls in vicinity of Turbine 13 must be undertaken under archaeological supervision and following completion of an archaeological photographic / scaled drawing / descriptive record.
- The removal of any stone field walls by the construction of the access roads to Turbines 7 and 11 should be monitored by a suitably qualified and experienced archaeologist.
- A report on the results of the licensed monitoring etc., should be submitted to the National Monuments Service and Galway County Council on completion.

16.2.8.2. Operation Stage - Mitigation Measures

No archaeological measures or monitoring, other than that included in the EIS relating to the Permitted Development is required during the operation phase.

16.2.9. Noise and Vibration (Chapter 12)

16.2.9.1. Construction Stage - Mitigation Measures

As the wind turbine construction methods will be the same as those for the Permitted Development, the mitigation measures presented in the previous EIS apply also to the Proposed Development, re-iterated here:

Reference will be made to British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise, which offers detailed guidance on the control of noise & vibration from demolition and construction activities. The following best practices will be employed:

- limiting the hours during which site activities likely to create high levels of noise or vibration are permitted;
- establishing channels of communication between the contractor/developer, Local Authority and residents;
- appointing a site representative responsible for matters relating to noise and vibration;
- monitoring typical levels of noise and vibration during critical periods and at sensitive locations;
- keeping site access roads even to mitigate the potential for vibration from lorries.
- selection of plant with low inherent potential for generation of noise and/ or vibration;
- placing of noisy / vibratory plant as far away from sensitive properties as permitted by site constraints, and;
- regular maintenance and servicing of plant items.

Noise

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

- No plant used on site will be permitted to cause an on-going public nuisance due to noise.
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
- Any plant, such as generators or pumps, which is required to operate outside of general construction hours will be surrounded by an acoustic enclosure or portable screen.
- During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Table 11.1 using methods outlined in British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.
- The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 7:00hrs and 19:00hrs Monday to Saturday. However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (i.e. concrete pours, rotor/blade lifting) it could occasionally be necessary to work out of these hours.

Where rock breaking is employed, the following are examples of measures that will be employed, to mitigate noise emissions from these activities:

- Fit suitably designed muffler or sound reduction equipment to the rock breaking tool to reduce noise without impairing machine efficiency.
- Ensure all leaks in air lines are sealed.
- Use a dampened bit to eliminate ringing.

- Erect acoustic screen between compressor or generator and noise sensitive area. When possible, line of sight between the top of machine and reception point needs to be obscured.
- Enclose breaker or rock drill in portable or fixed acoustic enclosure with suitable ventilation.

16.2.9.2. Operation Stage - Mitigation Measures

An assessment of the operational noise levels has been undertaken in accordance with best practice guidelines and procedures as outlined in Section 12.2.1.2 of this EIAR. The findings of the assessment confirmed that the predicted operational noise levels will be within the relevant best practice noise criteria curves for wind farms at all locations and therefore no mitigation measures are required.

If alternative turbine technologies are considered for the site an updated noise assessment will be prepared to confirm that the noise emissions associated with the selected turbines will comply with the relevant operational criteria associated with the grant of planning for the Proposed Development. If necessary, suitable curtailment strategies will be designed and implemented for alternative technologies to ensure compliance with the relevant noise criteria curves, should detailed assessment conclude that this is necessary.

In the unlikely event that an issue with low frequency noise is associated with the Proposed Development, it is recommended that an appropriate detailed investigation be undertaken. Due consideration should be given to guidance on conducting such an investigation which is outlined in Appendix VI of the EPA document entitled Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (EPA, 2016). This guidance is based on the threshold values outlined in the Salford University document Procedure for the assessment of low frequency noise complaints, Revision 1, December 2011.

In the unlikely event that a complaint is received which indicates potential amplitude modulation (AM) associated with turbine operation, the operator shall employ an independent acoustic consultant to assess the level of AM in accordance with the methods outlined in the Institute of Acoustics (IOA) Noise working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) namely, A Method for Rating Amplitude Modulation in Wind Turbine Noise (August 2016) or subsequent revisions.

The measurement method outlined in the IOA AMWG document, known as the 'Reference Method', will provide an indicator of AM and yield important information on the frequency and duration of occurrence, which can be used to evaluate different operational conditions including mitigation.

Monitoring

Post commissioning noise surveys are recommended to ensure compliance with any noise conditions applied to the Proposed Development. In the unlikely instance that an exceedance of these noise criteria is identified, the assessment guidance outlined in the IOA GPG and *Supplementary Guidance Note 5: Post Completion Measurements (July 2014)* should be followed and relevant corrective actions will be taken if deemed necessary. For example, implementation of noise operational modes resulting in curtailment of turbine operation can be implemented for specific turbines in specific wind conditions to ensure predicted noise levels are within the relevant noise criterion curves/planning conditions.

Post-commissioning of the Proposed Development turbines, it is recommended that the noise monitoring detailed in the relevant section of this report be repeated with consideration of the guidance outlined in the IOA GPG and Supplementary Guidance Note 5.

16.2.9.3. Decommissioning Stage - Mitigation Measures

In relation to the decommissioning phase, similar overall noise levels as those calculated for the construction phase would be expected, as similar tools and equipment will be used. The noise and vibration impacts associated with any decommissioning of the wind turbines are considered to be comparable to those outlined in relation to the construction of the Permitted Development. With reference to the Construction Environmental Management Plan, there is no item of plant that would be expected to give rise to noise levels that would be considered out of the ordinary or in exceedance of the levels outlined in Section 12.2.1.1.

Considering that in all aspects of the construction and decommissioning the predicted noise levels are expected to be below the appropriate Category A value (i.e. 65dB $L_{Aeq,T}$) at current noise sensitive locations for the decommissioning phase, therefore the noise and vibration effects are not significant.

The mitigation measures that will be considered in relation to any decommissioning of the site are the same as those proposed for the construction phase of the development, i.e. as per Section 12.4.2.

16.2.10. Air Quality and Climate (Chapter 13)

16.2.10.1. Air Quality Construction Stage - Mitigation Measures

Chapter 13 notes that the Proposed Development has been assessed as having a low risk of dust soiling impacts and dust related human health impacts during the construction phase as a result of earthworks, construction and trackout activities (see Section 12.4.2.2). Therefore, the following dust mitigation measures shall be implemented during the construction phase of the proposed development. These measures are appropriate for sites with a low risk of dust impacts and aim to ensure that no significant nuisance occurs at nearby sensitive receptors. The mitigation measures draw on best practice guidance from Ireland (DCC, 2018), the UK (IAQM (2014), BRE (2003), The Scottish Office (1996), UK ODPM (2002)) and the USA (USEPA, 1997). Specific attention has been given to the measures required by Dublin City Council in their document *Air Quality Monitoring and Noise Control Unit's Good Practice Guide for Construction and Demolition* (DCC, 2018). These measures will be incorporated into the overall Construction Environmental Management Plan (CEMP) prepared for the site. The measures are divided into different categories for different activities.

Communications

- The name and contact details of a person to contact regarding air quality and dust issues shall be displayed on the site boundary, this notice board should also include head/regional office contact details.

Site Management

- During working hours, dust control methods will be monitored as appropriate, depending on the prevailing meteorological conditions. Dry and windy conditions are favourable to dust suspension therefore mitigations must be implemented if undertaking dust generating activities during these weather conditions.
- A complaints register will be kept on site detailing all telephone calls and letters of complaint received in connection with dust nuisance or air quality concerns, together with details of any remedial actions carried out.

Preparing and Maintaining the Site

- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.
- Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.

- Fully enclose specific operations where there is a high potential for dust production and the site is active for an extensive period.
- Avoid site runoff of water or mud.
- Keep site fencing, barriers and scaffolding clean using wet methods.
- Remove materials that have the potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below.
- Cover/ seal, seed or fence stockpiles to prevent wind whipping.

Vehicles / Machinery and Sustainable Travel

- Ensure all vehicles switch off engines when stationary - no idling vehicles.
- Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.
- Impose and signpost a maximum-speed-limit of 20 kph haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate).Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.
- Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
- Use enclosed chutes and conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
- Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.

Waste Management

- Avoid bonfires and burning of waste materials.

Measures Specific to Construction

- Avoid scabbling (roughening of concrete surfaces) if possible.
- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.
- Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.
- For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust.

Measures Specific to Trackout

- A speed restriction of 20kph will be applied as an effective control measure for dust for on-site vehicles.
- Street and footpath cleaning must be undertaken during the ground works phase to minimise dust emissions. This can be carried out using water-assisted dust sweeper(s). If sweeping using a road sweeper is not possible due to the nature of the surrounding area then a suitable smaller scale street cleaning vacuum will be used.
- Avoid dry sweeping of large areas.
- Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
- Record all inspections of haul routes and any subsequent action in a site log book.
- Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).

Monitoring

- Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.
- Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked.

16.2.10.2. Climate Construction Stage - Mitigation Measures

The construction phase of the proposed development is predicted will be offset during operation. However, to ensure impacts are minimised as much as possible during the construction phase of the proposed development, all contractors will ensure that machinery used on site is properly maintained and is switched off when not in use to avoid unnecessary exhaust emissions from construction traffic. Consideration will be given to the reuse and recycling of materials where possible in order to reduce waste from the site.

16.2.10.3. Air Quality Operation Stage - Mitigation Measures

The supply of additional renewable electricity to the national grid will lead to a net saving in terms of NO_X emissions which may have been emitted from fossil fuels to produce electricity. This is considered a slight positive, long-term impact to air quality.

16.2.10.4. Climate Operation Stage - Mitigation Measures

There are no predicted adverse potential effects to climate during the operational phase of the proposed development. The impact of GHG emissions from the proposed project aligns with Ireland's GHG trajectory to net zero by 2050 as per TII Guidance (TII), this is therefore considered a significant positive, long-term impact to climate.

16.2.11. Population and Human Health (Chapter 14)

16.2.11.1. Construction Stage - Mitigation Measures

Chapter 14 notes that the Permitted Development EIS identified that no significant mitigation was required for population and human health during the construction phase. In particular it noted that no mitigation measures were proposed in terms of the local economy as the development will have a slight positive impact on the area. However, it recommended the following measures in relation to health and safety, good construction management practice and construction traffic management.

- Both the Design and Construction phases will be managed in line with the Safety, Health and Welfare at Work (Construction) Regulations 2006 (S.I. No. 504 of 2006) and amendments. The project Safety and Health Plan will be developed in line with the regulations and the duties of the Project Supervisor Design Process (PSDP) and the Project Supervisor Construction Stage (PSCS). The site will have restricted access during construction, and will be developed by an experienced, insured contractor operating in line with a method statement and safe systems of work. It should be noted that the wind farm will be located on private land, to which members of the public have no automatic right of access until operational.

- During construction, good management practice should be applied on site to ensure dust control measures are adequate, and that stockpiled materials and roads are maintained to a high standard. The impact from construction vehicle emissions can be reduced through ensuring the quality and maintenance of vehicles and plant and through the prohibition of vehicle idling.
- The potential negative impacts associated with traffic movements during the construction phase can be mitigated through a number of measures. Local residents should be warned in advance of any large volumes of HGV traffic. Signage relating to the construction traffic routes should be agreed with Galway County Council. Turbine delivery should be agreed with Galway County Council and the Gardaí to ensure that the effect on the public is minimised.

It is considered that these measures, in addition to the specific mitigation measures included in the Noise, Air Quality and Climate Chapters, as incorporated into the CEMP (ref. Appendix 2.1), will ensure that any potential impacts are minimised.

16.2.11.2. Operation Stage - Mitigation Measures

The regular maintenance, safety and inspections procedures as set out in the Permitted Development EIS will ensure any risks posed to human health are negligible. All mitigation as outlined under the Noise, Shadow Flicker, and Land and Soil section of this EIAR has been incorporated into the CEMP (ref. Appendix 2.1) and will be implemented in order to reduce, insofar as possible, potential adverse impacts on residential amenity at properties located in the vicinity of the Proposed Development works.

In relation to Shadow Flicker, as outlined in Section 14.4.3.6 and in Appendix 14.1, in the event of shadow flicker exceedances, screening measures will be discussed with the affected landowner. If is it not possible to mitigate these effects with screening measures wind turbine control measures will be implemented. These measures will safeguard all dwellings in the vicinity from any effects arising from shadow flicker.