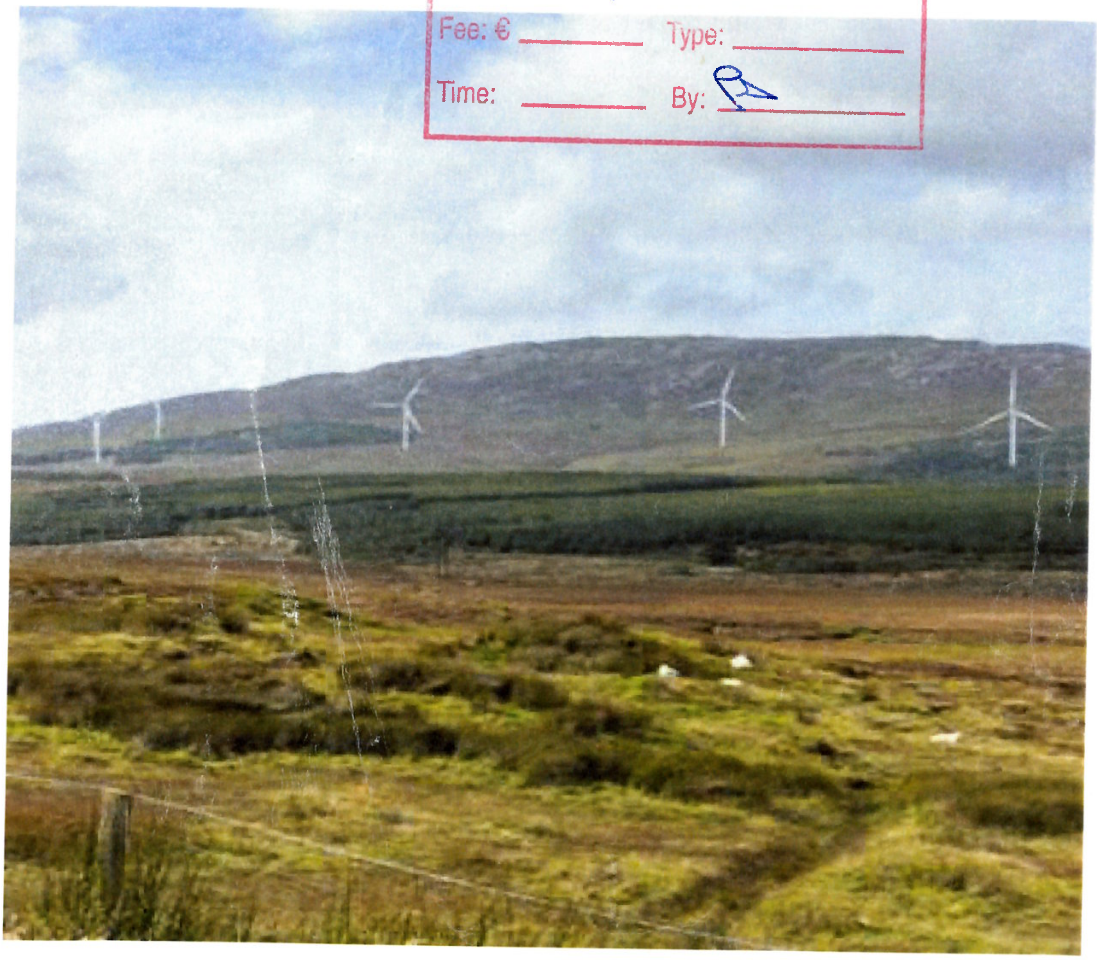
Graffy Wind Park



ENVIRONMENTAL IMPACT
ASSESSMENT REPORT (EIAR)

VOLUME 2: MAIN REPORT

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VAT REG. NO. 186028888

21/51990

GRAFFY WIND PARK, GLENTIES COUNTY DONEGAL

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR)

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CONTENTS

Preamble

In September 2010, Donegal County Council decided to grant planning permission to PJ Molloy for a wind park in the townlands of Graffy, Meenaleenaghan, Dalraghan More, Meenamanragh, Meenavale, Greenans, Stralinchy & Mully for the development of 19 turbines, a control building, ESB substation and compound and associated site roads and works – planning reference 09/30520. The decision was appealed and by its decision dated 11th February 2011 (PL 05B.237656), An Bord Pleanala granted the development of 13 turbines and associated works.

It is now proposed to develop and repower the wind park by reducing the number of turbines to eight (8) larger and more efficient turbines. The turbine types to be assessed are set out in Table 1 below. One or other of the models will be erected.

Table 1: Turbine models assessed in EIAR.

Turbine Model	Hub Height	Rotor Diameter	Blade Tip Height	Blade Length
Enercon 126	85.94 metres	127 metres	149.44 metres	61.09 metres
Nordex 133	83 metres	133.2 metres	149.6 metres	64.4 metres

A connection to the national grid, a substation, a permanent meteorological mast and delivery route strengthening also form part of the application. For convenience, the amended project will be referred to as the Graffy Wind Park.

This EIAR (Environmental Impact Assessment Report) assesses the environmental impacts of the wind turbines in combination with a grid connection between the proposed wind park control building and the existing Eirgrid substation at Tievebrack, approximately 7.5 kms to the west.

The identification of the turbine dimensions, was based on an energy yield assessment for the site, the wind regime and local environmental constraints. The assessment of two turbine models, is to overcome future withdrawal of models by the manufacturing companies. The amended delivery route serving the project will be along public roads from the east and will obviate the need for a replacement of the bridge over the Stracashel River, which was required for the planning permission PL 05B.237656. This planning permission expired on 10th February 2021 last. This delivery route will reduce impacts on houses in the vicinity, as fewer houses are located along that route.

The developer has applied for and been accepted for the project's inclusion in the RESS 1 auction, applications for which closed on 30th April 2020. The anticipated capacity for the wind farm is 35.88MW. Eirgrid intends that the Graffy Wind Park is to be connected to the ESB station at Tievebrack using a medium voltage (110kV) underground cabling connection from a proposed control building at Meenagrubby. The connections from the turbines to the proposed substation will be a maximum of 33kV.

Irish Government policy supports an increase in the capacity of electricity generation from renewable energy. EU Directive 2009/28 (June 2009) promotes the use of energy from renewable sources. Ireland is also obliged under the Kyoto Protocol to limit greenhouse gas emissions and wind energy represents one of the most immediate options for doing this.

Ireland has a huge potential energy resource in wind power. Strong Atlantic frontal systems flowing across the country provide Ireland with enough wind power to potentially supply 19 times Ireland's electricity requirements from onshore resources alone.

Ireland currently depends largely on fossil fuels for its energy needs, accounting for 91.9% of 2016 total primary energy requirements (TPER) (*Energy in Ireland 1990-2016*, SEAI December 2017), but showing an overall downward trend from 1990 when it accounted for 98.2% of TPER. The share of TPER and usage trends for each of the energy sources is summarised in Table 2 (source SEAI).

Table 2: Growth Rates, Quantities & Share of TPER by Sector

Fuel Type	Overall Growth %		Average Annual Growth %			Quantity (ktoe)		Shares %	
	'90-'16	'05-'16	'05-'16	'10-'16	2016	2005	2016	2005	2016
Fossil Fuels (Total)	42.0	-13.1	-1.3	-0.9	5.0	15,254	13,250	96.5	91.9
Coal	-34.1	-27.0	-2.8	1.8	-3.7	1,882	1,373	11.9	9.5
Peat	-46.7	-4.0	-0.4	-0.5	-4.3	765	734	4.8	5.1
Oil	56.3	-24.3	-2.5	-0.9	3.8	9,130	6,911	57.8	48.0
Natural Gas	192.6	21.7	1.8	-1.7	12.4	3,477	4,231	22.0	29.4
Renewables (total)	590.5	210.2	10.8	9.1	0.3	373	1,158	2.4	8.0
Hydro	-2.3	7.9	0.7	2.2	-15.6	54	59	0.3	0.4
Wind	---	453.0	16.8	13.9	-6.5	96	529	0.6	3.7
Biomass	217.6	85.7	5.8	8.0	17.6	180	335	1.1	2.3
Other Renewables	9,883.6	448.3	16.7	4.2	0.3	43	236	0.3	1.6
Wastes (Non-Renewable)	---	---	---	40.6	-3.8	---	66	---	0.5
Electricity Imports (Net)	---	---	---	---	---	176	-61	1.1	-0.4
Total	51.8	-8.8	-0.8	-0.4	3.7	15803	14413	---	---

Notes: Ktoe – kilo tonnes of oil equivalent

The following are the main trends in the national fuel share:

- Overall primary energy use grew by 3.7% in 2016. Fossil fuels accounted for 92% of all energy used in Ireland in 2016. Demand for fossil fuels increased by 5% in 2016 to 13,250 ktoe but was 13% lower than in 2005.
- Coal use decreased by 3.7% and its share of TPER fell to 9.5% in 2016 down from 10.3% in 2015. Since 2005, coal demand has fallen by 27% (2.8% per annum).
- Peat use fell by 4.3% and its share of overall energy use was 5.1% in 2016.
- Oil continues to be the dominant energy source and maintained a 48% share of TPER in 2016. The share of oil in overall energy use peaked in 1999 at 60%. Consumption of oil, in absolute terms, increased by 3.8% in 2016 to 6,911 ktoe, but compared with 2005, oil demand in 2016 was 24% lower.
- Natural gas use increased in 2016 by 12.4% to 4,231 ktoe and its share of TPER increased to 29%. Natural gas use was 22% higher than in 2005.
- Total renewable energy increased slightly by 0.3% during 2016 to 1,158 ktoe. Hydro and wind decreased by 15.6% and 6.5% respectively as there was lower rainfall and less wind blowing in 2016 compared to 2015. Biomass use increased by 17.6% in 2016 to 335 ktoe and other renewables increased by 0.3% to 236 ktoe. The overall share of renewables in primary energy stood at 8% in 2016 down from 8.3% in 2015. Furthermore, approximately three quarters of the additional wind capacity deployed in 2016 was commissioned in the latter half of that year.
- Energy from non-renewable wastes decreased by 3.8% in 2016 to 66 ktoe and accounted for just 0.5% of primary energy.
- Ireland was a net exporter of electricity in 2016 switching from net imports of 58 ktoe in 2015 to net exports of 61 ktoe in 2016 – a difference of 119 ktoe.

Renewable contributions to electricity generation were targeted to increase to 40% by 2020. Wind energy was expected to represent most of this generating capacity, with installed capacity of wind in the Republic of Ireland needing to reach between 4,000MW and 4,500MW if that target was to be realised. In September 2018, there was 3,457MW of installed capacity of wind in Ireland, capable of producing 8,200GWhr (gigawatt hours) of electricity per annum, with 1,541MW connected by Eirgrid and 1,916MW connected by ESB. There is an additional 314MW of other renewable energy sources in Ireland. In Northern Ireland, there is 642MW of wind installed along with 28.6MW of non-wind renewable energy sources.

The Irish energy industry will derive the following benefits from the development of wind energy:

- Security of energy supply.
- Reduced reliance on fuel imports.
- Increased investment.
- Less pollution.
- Reduction in greenhouse gases.

The wind park site, which is the subject of this EIAR, is located in the townlands of Graffy, Dalraghan More and Meenamanragh, in County Donegal. The site is suitable for a wind park due to:

- It's suitability with regard to good predicted wind speeds. The wind speed atlas for Ireland indicates wind speeds of >8m/sec at 75m height above ground across the site.
- The site benefited from a planning permission PL 05B.237656, for a wind farm, which recently expired. The current proposal extends over a reduced area to that permitted under PL 05B.237656, with eight larger turbines to replace the permitted thirteen turbines. The proposed turbines will be located at, or very close to permitted turbine positions.
- Proximity to a suitable grid connection. Eirgrid proposes to connect the wind park to the ESB Tievebrack substation at Drumnalough. The grid connection is approximately 7.5 km long using underground cabling.
- Good access to the site. Delivery of over-sized loads from Killybegs will follow the national and regional road network to within 7.5 km of the site. Assessment of local roads confirms suitable access to the sites.
- There are minimal likely impacts on the surrounding residential amenity and no turbine is proposed within 600m of any occupied dwelling. There are twelve third-party houses within 1km of any turbine, all of which are financially involved in the project.
- Minimal likely impacts on the surrounding environment:
- The wind park is located in a rural upland area, where land use is primarily rough grazing for sheep. Conifer plantations are widespread in the area, with forestry within the central part of the site and adjacent to the eastern site boundary. There is evidence of small-scale historic turf cutting at the site and active turf cutting is occurring in the general area, particularly at the low-lying elevations. The site substation is located to the south of local road L-6743 in improved wet grassland, used for sheep grazing.
- The grid connection to the ESB substation follows local roads L-6743 and L-2593 to the east towards Glenties. Land use consists primarily of low intensity agriculture and

forestry. The eastern-most 2km of the grid connection follows a forestry road, passing a mink farm.

- Only one turbine (T1) is located within forestry. In addition, a new section of delivery route, adjacent to local road L-6733 to the northeast of the wind farm and a turbine access track between turbines T4 and T5/T6 are located within commercial forestry. Lands for compensatory re-afforestation have been identified by the developers.
- Apart from one turbine, the turbines are located at least 50m from streams and the watercourse within the 50m buffer does not support fish. The ecology assessment indicates that with mitigation, there will be no significant impact on flora, fauna or the aquatic environment.
- The site consists of gradual slopes, but at the turbine locations the ground is generally flat and areas of deeper peat have been avoided, minimising the risk of peat slippage.
- There are no archaeological features on the site or within 100m of the proposed turbines or any other site infrastructure. There will be no impact on known archaeology. Archaeological monitoring of topsoil stripping during the construction phase is proposed so any previously unrecorded archaeology will be identified.

The site is also suitable in terms of its elevation, and the local topography provides screening of the proposed turbines from the north.

The Applicant

The application is being made by Cuilfeach Teoranta.

The Consultants

Harley Planning Consultants (HPC Ltd): 1 Melmount Park, Strabane, Co. Tyrone BT82 9SU.

Jim Harley, the director of HPC, qualified as a Town Planner from Queens University, Belfast in 1980 and has worked for over 30 years in the public service in Ireland having held planning posts with Mayo, Roscommon, Louth and Donegal County Councils. For the past 14 years he has worked as a planning consultant in private practice. Since entering private practice in 2005 HPC has represented private clients in major retail, residential and industrial projects and made land use zoning submissions in relation to Local Area Plans and County Strategic Plans. HPC has particular experience in wind energy, having been involved in over 20 wind energy projects.

Keohane Geological & Environmental Consultancy (KGEC): Ivy House, Clash, Carrigrohane, Co. Cork.

KGEC is a Cork-based consultancy specialising in geological and environmental sciences. Mr. Dan Keohane has over 25 years' experience in environmental assessment. In the past 15 years, KGEC has prepared planning applications, EISs and/or geotechnical assessments for over 25 wind farm developments throughout Ireland and UK. He has also been involved in the construction of over 30 wind farms in Ireland.

Woodrow Sustainable Solutions Ltd: Main Street, Ballisodare, Co Sligo, F91 R9VC.

Will Woodrow MCIEEM, CEcoL of Woodrow Sustainable Solutions Ltd prepared the ecology assessment, bat assessment and Natura Impact Assessment for this proposed development. Will is a full member of the Institute of Ecology and Environmental Management and one of only a few Chartered Ecologists in Ireland and Northern Ireland. He has extensive wind farm experience gained in involvement with over 40 wind farm projects to date including bird, bat, habitat and protected species surveys, including surveys under licence. Will has undertaken bat surveys for EIAs for 18 wind farm proposals in the last 6 years and is also involved in post construction compliance monitoring on other sites. Will has been involved with pioneering appropriate survey approaches in the field, including monitoring 'at height' throughout the active bat season and has developed a good understanding of the way that bats use upland wind farm sites in varying conditions. Will has supplemented his bat survey experience over the past decade with formal training, including bat survey design, assessment and mitigation methodologies, bat capture and handling and advanced bat data analysis. Will holds NPWS licences for roost disturbance and for bat handling.

Dermot Nelis Archaeology: 36 Fingal Street, Dublin 8.

Dermot Nelis Archaeology has carried out numerous walkover surveys, testing and monitoring programmes. He has acted as Senior Archaeologist on several motorway road schemes for various County Councils/National Roads Authority and directed large-scale test trenching and multi-period excavations associated with those developments. In addition, he has prepared cultural heritage desk-based reports and Environmental Impact Assessments for wind farms, road schemes, mineral extraction sites, retail parks *etc.*

RPS: Enterprise Fund Business Centre, Ballyraine, Letterkenny, Co. Donegal.

Founded in 1970, RPS is a leading global professional services firm of 5,600 consultants and service providers. Operating in 125 countries across six continents. RPS undertake ecology surveys and deliver cost-effective, innovative solutions to mitigate impacts on local habitats for all terrestrial, freshwater, coastal and marine environments. With over 25 years of global experience, RPS is expert in overcoming complex ecological issues and steering the planning process.

AECOM: 24 Lower Hatch Street, Dublin, D02 TY88.

AECOM is a global network of experts working with clients, communities and colleagues to develop and implement innovative solutions to the world's most complex challenges. AECOM is one of the leading teams in the development of Landscape and visual impact assessment of projects.

Irwin Carr Consulting (ICC): 121 Ormeau Road, Belfast, BT7 1SH.

ICC have particular expertise in wind farm assessment where current staff have co-authored the Institute of Acoustics Good Practice Guide as well as advising the Sustainable Energy Authority of Ireland (SEAI) in relation to the updates to the Wind Energy Development Guidelines in the Republic of Ireland. In addition to environmental noise, ICC offers specialist services in air quality.

Canavan Associates 23 Prince's Street Derry BT48 7EY.

With over twenty-five years of experience, Canavan Associates is an established and well recognised firm of Chartered Town Planners, Registered Architects, Environmental and Wind Energy Consultants. The practice provides a full range of services in town planning, architecture, environmental assessment and general development. The company has specialist expertise in wind and renewable energy development, quarries and Environmental Impact Assessments.

KH Chartered Engineers The Innovative Centre, Bay Road, Derry, BT48 7TG.

With 15 years' experience in the construction industry, KH Chartered Engineers carry out a range of geometric designs and traffic reports and offer advise on key considerations in the area of Highways/Roads Engineering, Traffic Engineering and Civil Engineering.

EIAR Structure

An EIAR is required for developments which fall within category 3(i) of the Fifth Schedule Part II of the Planning & Development Regulations 2001 (S.I. 600 of 2001):-

'Installations for the harnessing of wind power for energy production (wind farms) with more than 5 turbines or having a total output of greater than 5 megawatts'

The proposal is for the installation of eight turbines, with a rated capacity of 4.485MW, which will result in a potential installed capacity of 35.88MW. It therefore meets the criteria of category 3(i), requiring an EIAR.

The EIAR has been prepared using the grouped format structure as recommended in the EPA's '*Guidelines on the Information to be contained in Environmental Impact Statements*, '*Advice Notes on Current Practice (in the Preparation of Environmental Impact Statements)*', '*Revised Guidelines on the information to be contained in Environmental Impact Statements*' and '*Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*'.

Using the grouped format structure, the EIAR examines each topic as a separate section. Each specialist section refers to the relevant specialist topic using the following general structure:

- the existing environment
- impacts of the proposed development, which takes account of the other nearby permitted and proposed wind park developments.
- mitigation measures.

The EIAR is submitted in three volumes:

- Volume 1: Non-Technical Summary
- Volume 2: Main Report
- Volume 3: Appendices

The non-technical summary provides an overview of the work presented in the main body of the EIAR. It is a shortened and simplified version of Volume 2, but contains all the key information presented in a non-technical format.

Scoping of the EIAR was developed from the Sixth Schedule of the Planning & Development Regulations 2001 and in consultation with the relevant organisations. The main body of the EIAR describes the proposed development, and examines the impact of the proposed development on the environment. Table 3 below highlights the various environmental topics, together with the professional experts addressing those topics.

For each topic, the potential impacts and mitigations are discussed. Cumulative impacts are also assessed, where appropriate, as is the grid connection route to Tievebrack ESB substation. The landscape and visual impact assessment also considers wind parks in the wider area.

TABLE 3: Environmental topics & professional experts

Prescribed Environmental Factor	EIAR Chapter Heading	Topics Addressed	Company Preparing Chapter
Population & Human Health	Population & Human Health	Demographics; Health & Safety; Socioeconomics; Tourism	Canavan Associates
	Noise	Noise-Cross reference to health	Irwin Carr
	Shadow Flicker	Shadow Flicker Modelling	Canavan Associates
Biodiversity	Biodiversity	Flora, fauna, birds, bats aquatic ecology, FPM	Woodrow Sustainable Solutions Ltd; RPS
Land	---	Land use is addressed in other chapters including landscape.	
Soil	Soils, Geology & Hydrogeology	Overburden; Bedrock; Hydrogeology; Peat Stability	Keohane Geological Environmental Consultancy
Water	Surface Water & Hydrology	Water Quality; Water Use; Runoff Volumes & Treatment Capacity; Flooding	Keohane Geological Environmental Consultancy
Air & Climate	Air, Climate & Climate Change	Air Quality; Local Climatic Conditions; Climate Change; Carbon Payback	Irwin Carr
Material Assets	Material Assets	Roads & Traffic; EM Transmissions	KH Chartered Engineers
Cultural Heritage	Cultural Heritage	Archaeology; Cultural Heritage; Architecture	Dermot Nelis
Landscape	Landscape & Visual Assessment	Landscape Context Landscape Character Views & Prospects	AECOM

1. INTRODUCTION

Table of Contents

1.1 Global, EU and National Policy

Wind energy development and its inherent benefits are supported by global, national and local policy. The historic policies and strategy documents leading to, and underpinning, the current framework in which the proposal should be considered include:

- Kyoto Protocol, 1997 – sets targets for the reduction in the emission of greenhouse gases. Under Kyoto, industrialized countries agreed to reduce their collective greenhouse gas emissions by 5.2% compared to the year 1990.
- EU White Paper on Renewable Sources of Energy, November 1997- sets a strategy to supply 12% of EU energy requirements from renewable sources by 2010.
- Campaign for Take Off, April 1999 - sets out the action plan for the implementation of the White Paper.
- Green Paper on Sustainable Energy, 1999 – sets an initial target for renewable energy capacity in Ireland at 500MW by 2005. Further targets to be set up to 2010
- Strategy for Intensifying Wind Energy Deployment, 2000 - Arising from one of the recommendations of the Green Paper, the Renewable Energy Strategy Group was established. Their report presents recommendations for the future growth of the wind energy industry in Ireland. This is a key report for the industry.
- National Climate Change Strategy, 2000 – relates the growth of renewable energy capacity with achievement of Ireland's obligations under the Kyoto Protocol.
- Consequent to the EU White Paper, Directive 2001/71/EC addresses the obligation of Member States to establish a programme to increase the gross consumption of electricity from renewable energy sources. This directive sets out indicative targets for each Member State and discusses support schemes. The target set for Ireland was to increase green electricity from 3.6% (1997 figure) to 13.2% by 2010.
- European Council – Climate and energy policy framework to 2030 (October 2014) sets out new targets for carbon emission reduction and renewable energy penetration, increased energy efficiency and installation of interconnector infrastructure.
- The endorsement by EU leaders in December 2020 to a binding EU target for a net domestic reduction of at least 55% in greenhouse gas emissions by 2030 compared to 1990.

- The adoption of the EU's first climate law in June 2021, which enshrines into legislation the objective of a climate-neutral EU by 2050.

Government policies and strategies which outline targets for increased renewable energy deployment are:

- Green Paper – Towards a Sustainable Energy Future for Ireland (October 2006), sets a new target of 15% by 2010 of electricity consumption to be met by renewable energy, with a further target of 30% penetration by 2020.
- The Energy Policy Framework 2007-20 - Delivering a Sustainable Energy Future for Ireland (March 2007) sets out the Governments Energy Policy Framework 2007-2020 to deliver sustainable energy future for Ireland. It establishes actions to address objectives such as security of supply, environmental sustainability and economic competitiveness.
- Strategy for Renewable Energy 2012-20 (May 2012) confirms the commitment of Government to support the renewable energy industry on environmental and economic grounds with the development of renewable being central to overall energy policy in Ireland
- A Government White Paper 'Ireland's Transition to a Low Carbon Energy Future 2015-2030' (December 2015) provides an energy update and framework to guide policy up to 2030. The Paper builds upon the Energy Policy Framework 2007-20 and takes into account the changes that have taken place in the energy sector since 2007.
- Climate Action and Low Carbon Development Act 2015 (December 2015) - provides for the approval of plans by the Government in relation to climate change for the purpose of pursuing the transition to a low carbon, climate resilient and environmentally sustainable economy.
- The National Development Plan 2018 - 2027 (NDP) sets out the investment priorities that will underpin the implementation of the National Planning Framework, Project Ireland 2040. Transitioning to a low-carbon and climate-resilient society and achieving sustainable mobility are vital strategic outcomes identified in the NPF.

- Ireland's draft National Energy & Climate Plan (NECP) 2021-2030 was submitted to the European Commission in December 2018. The draft NECP took into account energy and climate policies developed up to that point, the levels of demographic and economic growth identified in the Project 2040 process and included all of the climate and energy measures set out in the National Development Plan 2018-2027. The NECP was drafted in line with the current EU effort-sharing approach, before the new Government committed to achieving a 7% annual average reduction in greenhouse gas emissions between 2021 and 2030. The NECP does not reflect this higher commitment, but Ireland is currently developing those policies and measures and intends to integrate the revision of the NECP into the process.
- The National Climate Action Plan 2019 (June 2019), provides proposals for the arrival of a five-year carbon budget to be developed in 2020.
- The Climate Action & Low Carbon Development (Amendment) Act 2021, amends the Climate Action and Low Carbon Development Act 2015 to significantly strengthen the framework for governance of climate action by the State in order to realise national, EU and international climate goals and obligations. The Act will set Ireland on the path to net-Zero emissions no later than 2050, and to a 51% reduction in emissions by 2030.

1.2 Renewable Electricity Support Scheme in Ireland.

RESS (Renewable Energy Support Schemes) is the new Renewable Electricity Support Scheme in Ireland, with auctions to be held at frequent intervals throughout the lifetime of the scheme. This will allow Ireland to take advantage of falling technology costs and by not auctioning all the required capacity at once.

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

RESS auctions will be designed in line with trajectory targets identified in Ireland's NECP. The RESS-1 qualification application closing date was extended from Thursday 2 April 2020 to Thursday 30 April 2020.

1.3 Development Policy

There are a number of guidance documents, plans and strategy documents concerning wind park development. These include the Donegal County Development Plan 2018-2024, '*Wind Farm Development - Guidelines for Planning Authorities*' Department of the Environment, Heritage & Local Government, June 2006, the *Draft Wind Energy Development Guidelines* December 2019 by the Department of Housing, Planning and Local Government, the '*Strategy for Intensifying Wind Energy Deployment*', Renewable Energy Strategy Group 2000 and the, '*National Climate Change Strategy*', Department of the Environment and Local Government, 2000.

1.3.1 County Development Plan

The Donegal CDP 2018-2024 addresses the issue of wind farms in Chapter 8.2 Energy. However, arising from a High Court judicial review, certain wind energy provisions of the County Donegal Development Plan 2018-2024 [Section 6.5(c) and (f) of the Wind Energy standards at Part B: Appendix 3, Development Guidelines and Technical Standards and Map 8.2.1] were ordered to be deleted and/or removed from the County Donegal Development Plan 2018-2024. Despite the High Court decision and several Donegal County Council's decisions to refuse planning permission on the basis of a lacuna in wind energy policy, An Bord Pleanala has in all the cases overturned the Council's decision, citing that there is adequate wind energy policy at international, national, regional and even local level, to allow the developments.

Under Policy NH-P-6, it is a policy of the Council to protect areas identified as Especially High Scenic Amenity on Map 7.1.1: 'Scenic Amenity'. Within these areas, only developments assessed to be of strategic importance or developments that are provided for by policy elsewhere in this Plan shall be considered.

The wind turbines are located within an Area of Especially High Scenic Amenity (EHSA), but the site not located near any scenic route and is not identified within designated views in the County Donegal Development Plan 2018-2024. While Policy NH-P-6 is unclear regarding the extent of the strategic importance, it is considered that the proposed development is of strategic importance, nationally, regionally and locally, which allows for its consideration with EHSA areas. The development's strategic importance is highlighted as follows:Central to the success of Project Ireland 2040 [a combination of the The National Development Plan (NDP) and the National Planning Framework (NPF)], is the national objective of *achieving a transition to a competitive, low carbon, climate-resilient and environmentally sustainable economy by*

2050. The proposed development would have strategic importance to the North West region generally and specifically to County Donegal, which is isolated within the region.

- The proposed development would help fulfil National Policy Objectives under the National Planning Framework (NPF). In particular, NPO 54 in the NPF seeks to

'Reduce our carbon footprint by integrating climate change action into the planning system in support of national targets for climate policy mitigation and adaptation objectives, as well as targets for greenhouse gas emissions reductions'

In addition NPO 55 in the NPF, seeks to

'Promote renewable energy use and generation at appropriate locations within the built and natural environment to meet national objectives towards achieving a low carbon economy by 2050'

- The Regional Spatial and Economic Strategy (RSES) for the Northern and Western Region was adopted on 24th January 2020 and came into immediate effect. The RSES drills down from and supports the implementation of the National Planning Framework (NPF) and the relevant economic policies and objectives of the Government. RSES identifies the importance of a reliable, high-quality, electricity supply, which is particularly important if the region is to attract high technology industries. To ensure the NW region has sufficient capacity and resilience in its electricity supply, RSES highlights, as an urgent priority for the region, the need for reinforcement of the electricity grid, which is predicated on the level of renewable generation in both Donegal and its hinterland in western Northern Ireland. The proposed development would support the robustness of the electricity to County Donegal and the NW region.

- The proposed development would make a significant contribution to meeting Ireland's renewable energy and greenhouse gas reduction targets, included in the Climate Action Plan 2019. It is anticipated that the development would be worth a significant amount to the regional and local rural economies.

- The proposed development would form a strategic cog in the Climate Action & Low Carbon Development (Amendment) Act 2021, enacted in July 2021. This Act amends earlier climate change targets, to significantly strengthen the framework for governance of climate action by the State in order to realise national, EU and international climate goals and obligations.

Despite the High Court case [Planree and Donegal County Council], which deleted certain aspects of the Donegal County Council wind energy policy, a significant level of policy on wind energy is provided for elsewhere in this Plan. As such, the development can be given consideration within EHSA areas. The policies are:

Policy E-P-2 It is a policy of the Council seeks to facilitate the appropriate development of renewable energy from a variety of sources, including, hydro power, ocean energy, bioenergy, solar, wind and geo-thermal and the storage of water as a renewable kinetic energy resource, in accordance with all relevant material considerations and the proper planning and sustainable development of the area.

Policy E-P-10 states it is the policy of the Council that development proposals for wind energy shall be in accordance with the requirements of the Wind Energy Development Guidelines – Guidelines for Planning Authorities 2006 (or as maybe amended).

Policy E-P-14 states that it is the policy of the Council to support voluntary initiatives from developers/renewable energy operators for community benefits, in accordance with other policies of this plan and the proper planning and sustainable development of the area.

Policy E-P-16 states it is the policy of the Council to support the strengthening and enhancement of the capacity of existing wind farms, within the local environmental capacity including the sustainable upgrade/replacement of older turbines with newer more efficient models.

Policy E-P-20 states that it is the policy of the Council that proposals for renewable energy development will have regard to the cumulative effect of the development on the environment when considered in conjunction with other existing and permitted developments in the area.

Policy E-P-21 states that it is the policy of the Council that all applications for renewable energy projects will ensure that details of the proposed grid connection and all associated infrastructure, are considered in any Environmental Impact Statement and Natura Impact Statement as maybe required.

Tourism Policy TOU-P-5 in the County Donegal Development Plan 2018-2024, confirms that the Council will not to permit development which would materially detract from visual and scenic amenities along the route of the Wild Atlantic Way. The route of the Wild Atlantic Way lies over 10kms to the west of the Graffy Wind Farm and only long distance views are afforded from the route, which the Landscape and Visual Impact Assessment considered to be negligible.

1.3.2 Other Relevant Policy and Strategy Documents

Local Authorities have been using the Department of the Environment, Heritage & Local Government Guidelines to assist in the consideration of planning applications for wind parks. These guidelines were published first in 1996, were revised in 2004 (and issued as draft) and were finalised in June 2006. The Guidelines act as the guiding principles for Planning Authorities when they are deciding planning applications for wind parks. The Guidelines offer advice on many aspects of wind parks such as the siting of turbines, impacts on the local environment and natural heritage and the effect that wind parks have on the landscape. The Guidelines are not prescriptive in nature, as they recognise that each location is different and should be treated as such.

In December 2013, the Department of Environment, Community and Local Government (DoECLA) published proposed revisions to the 2006 Guidelines for public consultation. The proposed revisions to the 2006 Guidelines relate to noise, proximity to houses and shadow flicker. On 13 June 2017, the DCCAE and DHPCLG published a 'preferred draft approach' to the review of the 2006 Guidelines. The proposed approach focuses on six key aspects – sound/noise, visual amenity setback, shadow flicker, consultation obligations, community dividend and grid connections.

Finally, in December 2019, the Department of Housing, Planning and Local Government, published the Draft Wind Energy Development Guidelines, which will supercede the 2006 Guidelines, when adopted. The new Draft Guidelines primarily focus on addressing a number of key aspects including noise, visual amenity, setback, shadow flicker, community consultation obligations, community dividend and grid connections. At the time of writing, the new guidelines have yet to be formally adopted.

1.4 Need for the Proposed Development

Renewable energy is recognised as having a vital part to play in Ireland meeting its Kyoto targets for the reduction of greenhouse gas emissions. The Irish Government implemented the National Climate Change Strategy to allow these targets to be met. Ireland has long been dependant on fossil fuels to produce energy and it's peripheral location in Europe and its reliance on non-renewable sources of energy, has left the country in a vulnerable position in terms of future energy provision and its costs.

Renewable energy sources are not only an opportunity for Ireland to reduce its greenhouse gas emissions and its reliance on foreign sources of energy, but also an opportunity to create employment within the energy industry.

Wind energy is recognised as the renewable source of energy, which is the fastest and most economical to put into operation. As such, it is of vital importance in the short to medium term in Ireland's national policy regarding the production of green energy.

While the Arklow Bank offshore wind turbines contribute to the national grid (25MW installed capacity) the provision of additional onshore wind parks remain vital to achieving targets for the reduction of greenhouse gas emissions. There have been no additional offshore wind farms installed in Irish waters since the Arklow Bank construction in 2004. Land-based wind parks continue to provide the most economically viable means of exploiting wind energy, and its development is likely to continue as a strong element of national renewable energy policy for some time to come. While several off-shore wind park projects were included in GATE 3, none have been progressed and indeed some off-shore grid capacity has been relocated to on-shore sites.

Wind energy offers the opportunity for Ireland to reduce its greenhouse gas emissions. while adding power to the national electricity grid. It will reduce the country's reliance on imported sources of energy, while using indigenous resources and creating employment. The cost of generating energy from wind is made up primarily of the capital cost, with low operational costs, which ensures energy price stability.

1.5 Benefits of Wind Energy Development

The benefits of wind energy include the following:

- Provision of much needed electrical capacity.
- Zero greenhouse gas emissions to the atmosphere during operation and contribution towards attainment of Kyoto targets.
- Abatement of other pollutants and environmental protection.
- Reduction of energy importation.
- Use of indigenous resources.
- Security of energy supply.
- Improvement of the balance of payments. Ireland paid €3.4 billion for fuel imports in 2016, down from €4.6 billion in 2015.
- Energy price stability.

- Contribution to sustainable development.
- Avoidance of fines for not meeting 2020 targets.

1.6 Costs of Wind Energy Development

The costs associated with wind energy include both economic and environmental costs and are described below.

Economic Cost

The cost of wind energy is influenced by technical factors such as the wind speed at the site, wind turbine availability and price, position of the turbines and the cost of finance. The cost of generating electricity from wind is made up primarily of the capital cost, with low operational costs.

Wind energy is probably the least expensive method of generating electricity in Ireland in terms of real costs, because it has low external costs and does not receive the level of subsidies paid to fossil fuel providers.

Environmental Cost

The environmental costs include land take, habitat loss, noise and visual impacts. In general, it is found that visual impact is the primary concern. These topics are discussed in greater detail in the following chapters.

1.7 Public Attitudes to Wind Energy

Throughout the development of wind energy technology, public attitudes towards clean and renewable energy generation have been surveyed regularly. In America and Europe public support has strengthened for cleaner and "greener" energy production.

On the whole, the public favours the development of renewable energy in combination with increased energy efficiency to meet energy needs.

In a research summary of independent studies in the UK, which canvassed individuals living close to an existing or proposed site, every study demonstrated that the overwhelming majority of residents in areas with a wind farm favour wind power, both in theory as a renewable energy source and in practice in their areas. While wind energy was, in general, highly supported, areas with a wind park had an even higher support rate. An average of 8 out of 10 people supported their local wind park. Other surveys had similar results including surveys in Wales, the Netherlands, Sweden and North America.

In Ireland, the Irish Wind Energy Association (IWEA) commissioned a survey by Drury Research, published in 1999. The survey found that:

- 67% of respondents agreed that the Government should support the development of wind energy in Ireland.
- 93% of those aware of wind energy are in support of its development.
- When asked to rank forms of energy in terms of their environmental friendliness, wind power attracted the highest mean score.
- Perceived disadvantages of wind power were much more likely to centre around its ability to provide a continuous power supply, more so than any perceived unsightliness.

In 2003, Sustainable Energy Ireland (SEI – now SEAI) completed a series of surveys on the attitude of the public towards wind parks in Ireland. The results show that Irish people are generally positively disposed to wind parks, with 8 out of 10 of those questioned favourable to the construction of more wind parks in Ireland.

A study was also carried out in 2004 by the School of Geography & Geoscience (University of St. Andrews) and The Macaulay Institute on the public perceptions of wind power in Scotland and Ireland. The study areas were in northeast Scotland and southwest Ireland. The study found that the majority of people are in favour of wind parks and that opposition subsided following the construction of a wind park, with opposition arising from exaggerated negative perception of the impacts.

In 2007, Fáilte Ireland in association with the Northern Ireland Tourist Board carried out a visitor survey on the attitudes of tourists, both domestic and overseas holiday-makers, to wind energy projects. The purpose of the survey was to access whether the development of wind parks would impact on the enjoyment of the Irish scenery by holiday-makers. The survey involved interviews with 1,300 tourists (25% domestic and 75% overseas), 1,000 in the Republic and 300 in Northern Ireland. The majority of the respondents (85%) perceived wind farms as a positive, with 15% negative towards wind farms. However, it found that the landscape onto which the wind farm is to be sited had a significant impact on attitudes. Although 15% considered wind energy projects as having a fairly or very negative impact on sightseeing, this figure increased to 33% for wind projects sited on coastal landscapes. Only 18% were opposed to wind farm construction on bogs and 13% on industrial land. A majority expressed a preference for wind farms with fewer, larger turbines.

1.8 Alternatives to Proposed Development

The importance of the consideration of the alternatives is highlighted in Section 2.4.3 of the EPA's revised "*Advice Notes on Current Practice (in the Preparation of Environmental Impact Statements*". The 2014 Directive requires '*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*'.

Alternatives to the proposed development can be considered in terms of:

- Alternative sites.
- Alternative site layout and design.
- Alternative technologies.

1.8.1 Alternative Sites

The assessment of alternative sites for the turbines is not realistically available to the applicant. The eight proposed turbines will be located generally at the positions of the turbines granted under the recently expired planning permission (PL 05B.237656). The original landowners own the lands on which the turbines are proposed and if granted, they will replace the permitted wind turbines on these sites.

1.8.2 Alternative Wind Park Design

The design and layout of the turbines was informed by the environmental and technical constraints associated with the site, including:

- Available land bank.
- Offset distances required from dwellings. It is preferable to keep the turbines a minimum distance of four times the blade diameter from third-party dwellings.
- In general, to ensure optimal performance and to account for turbulence and wake effects, minimum distances between wind turbines will be adhered to. Bearing in mind the requirements for optimal performance, a distance of not less than two rotor blades from adjoining property boundaries will generally be acceptable.
- Depth of peat.
- Positions of the permitted turbines. The proposed eight turbines are generally at the locations of previously permitted turbines.

The size of the turbines selected for the wind farm design optimises the predicted wind regime of the site. With rotor diameter of 132m, the proposed turbines will maximise the energy capture of the wind farm. Maximising the efficiency of the turbines at the site, increases the environmental and climate change benefits of the project by increasing the offset of greenhouse gases.

1.8.3 Alternative Technology

If the wind turbines are not developed, then fossil fuel power stations will likely be used to provide the required quantities of electricity. This will contribute to greenhouse gas and pollutant production.

The applicant selected the size of turbine, following an assessment of the energy yield for the site for different turbine types. The scale of the selected turbine offers the best solution for the wind class regime at the site.

1.8.4 Alternative Grid Connection

EirGrid intends that the Graffy wind farm is to be connected to the Tievebrack substation using a medium voltage (110kV) connection.

Medium voltage grid connections for wind farms are of three general types as follows:

- Overhead line mounted on single wooden poles, with guywire supports typically at changes in direction.
- Underground cable buried approximately 1.2m below ground level with cables pulled through PVC ducting or buried directly.
- A combination of overhead line and underground cable.

For the Graffy Wind Park, the grid connection point has been designated by EirGrid as Tievebrack substation and that the grid connection be underground. As such, there is no alternative grid connection end point or grid type to be considered. Alternative routes and design types have been considered as follows:

- Option 1 – Overhead line along the local public and private roads to the Tievebrack sub-station.
- Option 2 –Overhead line over privately owned lands to the Tievebrack sub-station.
- Option 3 –Underground line along the public and private roads to the Tievebrack Sub-station. This option offers the best solution for connecting the wind farm. Option 3 is the

only viable connection for the Graffy Wind Park. EirGrid has insisted that the grid connection be underground and located along private and public roads, where access to the grid connection would be available. In addition, feed-back from the local community confirmed that underground grid connection was the only acceptable option.

1.8.5 Technical Difficulties

There were no technical difficulties encountered during the environmental assessment conducted at the site.

1.9 Pre-Submission Consultation

In the course of the preparation of the EIAR, a number of organisations and individuals were contacted by email and letter on 1st May 2020, seeking comments on the project. Details of the consultation documentation is contained in Appendix 1.1. The organisations contacted are summarised in Tables 1-1 and Table 1-1A. Donegal County Council was also consulted for this development, but the Planning Authority did not engage with the Planning Consultant, Harley Planning Consultants, as it considered that there was no wind energy planning policy in place within its County Development Plan, to offer constructive advice.

Table 1-1: List of General Consultees

Organisation	Response Received
Donegal County Council	Development is EIAR and consideration should be given to the River Finn SAC and the West of Ardara/Maas Road SAC
Office of Public Works	No response
Irish Aviation Authority	No objection
Geological Survey of Ireland,	Records show a proposed CGS in the vicinity of the wind farm at Stralinchy.
Renewable & Sustainable Energy Division SEAI	No response
Inland Fisheries Ireland,	Ballyshannon office has advised that its submission on the permitted wind farm should be noted and that it would respond in due course on the new application.
Organisation	**Response Received**
EPA	No response

DAU, Department of Arts, Heritage and the Gaeltacht	No response
An Coimisinéir Teanga	No response
Department of Transport, Tourism and Sport	No response
Dept of Rural & Community Development	No response
Garda Siocahna	No response
An Taisce	No response
Birdwatch Ireland	No response
Ireland Peatland Conservation Council	No response
Irish Wildlife Trust	No capacity to consider response.
Irish Raptor Study Group	No response
TII	No response
Forestry Service	No response

Table 1.1A Telecommunications Companies

Organisation	Response
Radio Teilifis Eireann	No objection
Digiweb	No response
Towercom	No response
Tetra Ireland	No objection
Virgin Media Ireland,	No response
ESB Telecoms	No objection
Garda Telecommunications Section	No response
TG4	No response
Meteor Communications/EIR	No objection
Three Ireland (Hutchison) Limited.	No response
Vodafone Ireland	No objection
Broadcasting Authority Ireland	No objection
BT Ireland	No objection
EIR	No objection

1.10 Scoping

An initial scoping of possible impacts of the proposed development was carried out to identify those impacts thought to be potentially significant. This scoping study was carried out to examine the impacts in the various categories listed in the Sixth Schedule of the Planning & Development Regulations 2001, and as listed above in the Preamble. The level of work carried out for each topic reflects the potential impact on each area, as identified during the scoping process.

The scoping process was based on:

- Consultation with various stakeholders,
- Having regard to the various published guidelines and the County Development Plan.
- A review of the project documentation relating to the permitted wind park and the other nearby wind parks.
- Experience of the consultants in preparing environmental impact assessment reports.

1.10.1 Scope of EIAR

The emphases placed on potential impacts following the scoping process are described below:

Landscape and Visual Impact

The main objective of the landscape assessment is to evaluate the likely impact of the proposed development on the surrounding landscape. Depending on public perception, visual impact is likely to be the impact of greatest concern for wind turbines. Visual impact assessment includes the preparation of zone of theoretical visibility maps and photomontages from key viewpoints in the surrounding landscape and assessing the proposed turbines in the context of the operational and permitted wind parks. It also assessed the change in impact between the proposed larger turbines and the previously permitted ones. These are presented in Chapter

Noise

Locally, wind turbines can increase background noise levels. Noise modelling was carried out to assess the potential impacts and the results are included in Chapter 5 of this report. As the proposed turbines are sufficiently set back from third-party houses, the predicted noise levels from the proposed turbines are below relevant guidelines.

Population & Human Health

Potential impacts affecting human beings in the vicinity of the proposed wind farm include:

- Possible flickering shadows from the moving blades.
- Possible increased traffic on local roads.
- Possible impact on residential amenities.

These potential impacts are not expected to significantly affect human beings in the surrounding environment. Shadow flicker and residential amenity are addressed is Chapter 4. Using worst case assumptions, the model predicts shadow flicker at third-party houses arising from some of the proposed turbines. Traffic and road infrastructure is addressed in Chapter 11. Risk to human health in terms of accidents is considered in terms of peat landslide risk. This is discussed in Chapter 7.

Soils & Geology

The wind farm is located in a rural upland area in the upper catchments of the Stracashel River and along the foothills of Aghla Mountain. There is evidence of small-scale historic turf cutting at the site, with active turf cutting occurring in the general area, particularly at the low-lying elevations. The site substation is located to the south of local road L-6743 in improved wet grassland. Geology and peat landslide risk assessment is an important factor in wind farm construction on blanket bog sites. Geology, including an assessment of slope stability is provided in Chapter 6.

Surface Water & Hydrology

Construction of the turbine foundations, site access roads and cranage platforms could potentially alter the hydrology (and water quality) of the site depending on the depth of foundations and manner of construction. Potential impacts include an increase in surface water runoff, siltation of streams and alteration of bog hydrology. This topic is discussed in Chapter 7.

Air, Climate and Climate Change

The wind energy project will generate electricity that would otherwise be generated by fossil fuel burning power stations. The proposed development will therefore have a positive impact on climate. The aspects of climate that are important for shadow flicker and hydrology are included in those chapters. The development will have carbon losses associated with turbine manufacture, transport, use of concrete in its construction and carbon losses from excavated peat and soil. Carbon gains are associated with the generation of electricity from a renewable source. The carbon payback for wind farms is cited at timescales of 3 to 5 months on the IWEA website (http://www.iwea.com/index.cfm/page/environmentalimpacts?#q63).

Information on local climate is provided in Chapter 8 and in Chapter 7 as it relates to site hydrology and Chapter 4 as it relates to the occurrence of shadow flicker.

Archaeology & Cultural Heritage

The development could have a potential impact on the cultural heritage of the area. In particular, disturbance of the ground during construction of the wind farm could uncover previously unknown archaeological features. While there are no recorded monuments within the site, there is always potential to uncover previously unrecorded features. Monitoring of topsoil stripping during construction by an archaeologist under licence is therefore proposed to identify and preserve any archaeology if discovered. Dermot Nelis Archaeology prepared the archaeological assessment for the proposed development and included as Chapter 9.

Biodiversity – Flora, Fauna, Birds and Aquatic Ecology

Flora, Fauna, Birds and Aquatic Ecology are important factors for consideration in the assessment of the Graffy Wind Park. To assess potential impacts, assessments were carried out, including identification of habitats, identification of flora and fauna species, birds, bats and aquatic ecology impact assessment. Biodiversity is discussed in Chapter 10 under a comprehensive range of topics, including flora & fauna, avi-fauna, Bats, aquatic ecology with a specific assessment on the freshwater pearl mussel.

Land

Land uses on, and within the vicinity of the site is discussed in a number of chapters throughout the EIAR. Wind park development offers an attractive alternative land use. A specific chapter on land use is not considered necessary as the topic is covered sufficiently in a number of chapters.

Traffic

Impacts associated with traffic are considered in Chapter 11 of the EIAR. These involve assessments of the haul route to the site for delivery of turbines and construction materials. In addition the traffic impacts associated with the construction of the grid connection are also addressed.

Material Assets

Wind energy is one of Ireland's largest, commercially viable energy resources. The proposed development is not expected to have any significant impact on material assets and therefore material assets are not a primary consideration. This topic is discussed in Chapter 12.

Electro-Magnetic Effects

The rotating blades of a wind turbine can occasionally cause interference to electro-magnetically propagated signals. Such interference can, in theory, have an impact on all forms of electromagnetic communications such as cellular radio communications, aircraft instrument landing systems and television broadcasts. This topic is addressed in Chapter 13.

1.11 Contributors

The EIAR was co-ordinated by Harley Planning Consultants. Specialist consultants employed with reference to specific topics of the study are summarised in Table 1-2.

Table 1-2: Contributors to the EIAR

Keohane Geological & Environmental Consultancy: Ivy House, Clash, Carrigrohane, Co Cork.	Geology, Hydrogeology, Hydrology
AECOM Ltd.:24 Lower Hatch Street, Dublin, D02 TY88	Landscape & Visual Impact Assessment
KH Chartered Engineers: The Innovative Centre, Bay Road, Derry BT48 7TG	Planning Drawings & Material Assets
Harley Planning Consultants: 1 Melmount Park, Strabane, Co. Tyrone BT82 9SU	Overall EIAR Coordinator
Woodrow Sustainable Solutions Ltd Main Street, Ballisodare, Co Sligo, F91 R9VC,	Ornithological Assessment; Bat Assessment,
Dermot Nelis Archaeology: 7 Broomhill Park, Bangor, County Down, BT20 5QZ	Archaeological Impact Assessment
Irwin Carr Consulting: 121 Ormeau Road Belfast County Antrim BT7 1SH	Noise Impact Assessment; Air Quality
Canavan Associates Ltd: 23 Princes St, Londonderry BT48 7EY	Human Beings & Shadow Flicker Assessment
RPS, Enterprise Fund Business Centre, Business Park Road, Ballyraine Letterkenny, Co. Donegal F92 AF43	Terrestrial ecology; aquatic ecology; NIS, Freshwater Pearl Mussel

1.12 Format of EIAR

This document has been prepared in accordance with guidelines provided by the EPA included in:

a) Advice notes on Current Practice (in the preparation of Environmental Impact Statements.
b) Guidelines on the Information to be Contained in Environmental Impact Statements.
c) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports.

The document has been structured according to the direct format structure, as described in (b) above. The guidelines recommend that EIAR documents be kept as concise as possible. The report is submitted in three volumes:

Volume 1: Non-Technical Summary.

Volume 2: Main Report.

Volume 3, 3A, 3B: Appendices.

2. Description of Project

Table of Contents

Background:

In September 2010, Donegal County Council decided to grant planning permission to PJ Molloy for a wind park in the townlands of Graffy, Meenaleenaghan, Dalraghan More, Meenamanragh, Meenavale, Greenans, Stralinchy & Mully for the development of 19 turbines, a control building, ESB substation and compound and associated site roads and works – planning reference 09/30520. The decision was appealed and by its decision dated 11th February 2011 (PL 05B.237656), An Bord Pleanala granted the development of 13 turbines and associated works.

It is now proposed to develop and repower the wind park by reducing the number of turbines to eight (8) larger and more efficient turbines.

Description:

The wind park, consisting of eight wind turbines, is located in a rural upland area in the upper catchment of the Stracashel River and along the foothills of Aghla Mountain to the north of local road L-6743-2. Housing is sparse in the immediate area, consisting of a few farmhouses along the local roads, a number of which are now derelict. The land use is primarily rough grazing for sheep. Conifer plantations are widespread in the area, with forestry within the central part of the site and adjacent to the eastern site boundary. There is evidence of small-scale historic turf cutting at the site and active turf cutting is occurring in the general area, particularly at the low-lying elevations.

The site substation is located to the south of local road L-6743-2 in improved wet grassland, used for sheep grazing.

The grid connection to the ESB Tievebrack substation follows local roads L-6743-2 and L-2593-2 to the east towards the R250. Housing density increases to the east with farmhouses and rural housing development. Land use here consists primarily of low intensity agriculture and forestry. The eastern-most 2km of the grid connection follows a forestry road, passing a mink farm.

Due to turning limitations, a new road, traversing Coillte forestry is required adjacent to the junction of local roads L-2023-1 & L-6733-1 approximately 5.5kms to the northeast of the wind park. In addition, Turbine T1, a section of the grid connection route and a turbine track between turbines T4 and T5/T6, are also within Coillte commercial forestry lands. Finally easing of bends to facilitate turbine delivery will encroach on Coillte property. Agreement has been reached with Coillte for these developments and compensatory forestry will be provided, where felling is necessary.

The layout of the proposed development is shown on Figure 2-1 below and consists of:-

1. The development of eight turbines with an assessment of two turbine models, which are almost identical, but only one of the turbine models will be erected. The turbine models assessed for the development are the Enercon 126 and the Nordex 133 and their specification measurements are set out below in Table 1.

Table 1: Turbine models assessed for the development.

Turbine Model	Hub Height	Rotor Diameter	Blade Tip Height
Enercon 126	85.94 metres	127 metres	149.44 metres
Nordex 133	83 metres	133.2 metres	149.6metres

2. The development of a permanent meteorological mast.
3. Construction of access tracks to each turbine location.
4. Construction of crane hard standings and assembly areas for each turbine.
5. Cabling from each turbine to the substation.
6. Peat recovery areas
7. Grid connection from the proposed substation to the Tievebrack ESB station.
8. A temporary construction compound.
9. A new access track and widening/strengthening of existing roads to facilitate delivery of turbines.

2.1 Turbines

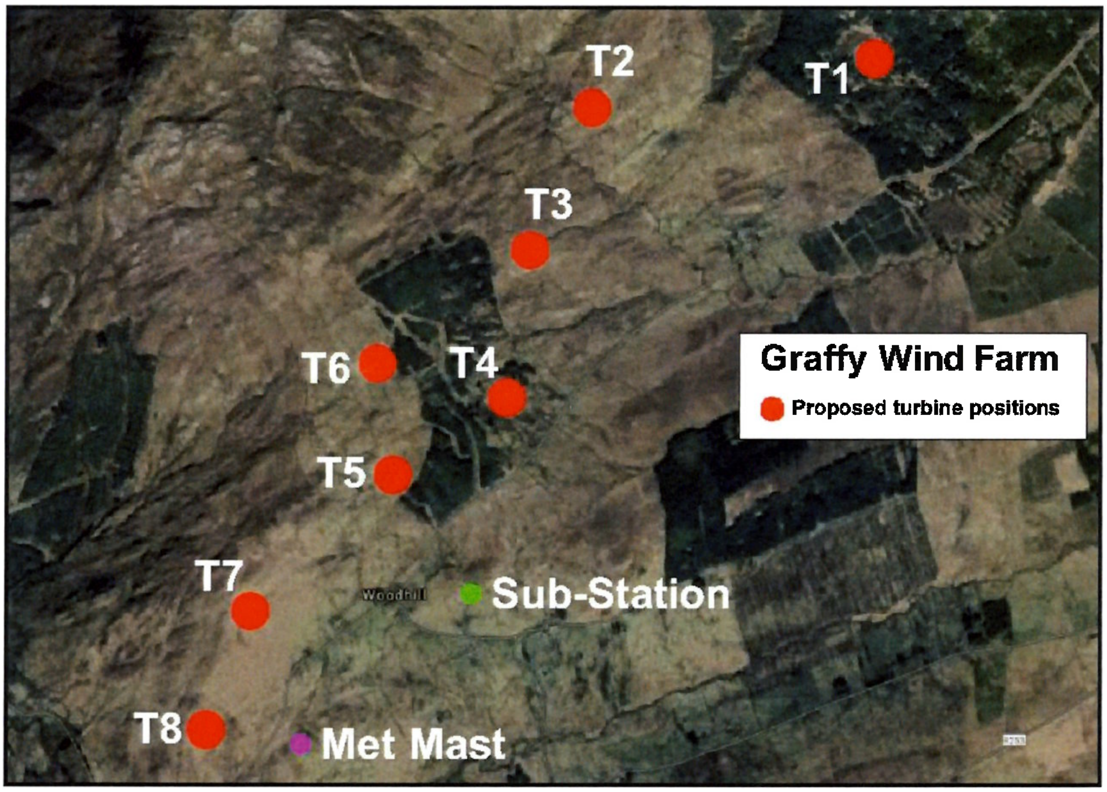
The site layout is presented in Figure 2-1. In accordance with Section 7.3 of the Wind Farm Guidelines, flexibility in the micro-siting of the turbines must be allowed for, primarily due to ground conditions – movement of up to 20m may be required, which due to the relatively flat topography at each turbine site will not result in a significant change of foundation elevation. Drawings of the turbines that are assessed for this development, accompanies the planning application in drawings 19-014-010A and 19-014-010B. The proposed turbines will be of the generic three bladed, tubular tower model with horizontal axis. The rotor blades are bolted to the central hub, which is connected to the nacelle. The nacelle holds the :-

- Generator / converter.
- Electrical components.
- Control units of the turbine (pitch and yaw).

Earthing and isolation protect these components from lightning strikes. A polyester hood made from reinforced glass fibre covers the nacelle. The hood is sound insulated to ensure minimal noise emissions. The blades of modern turbines are made of glass fibre reinforced polyester.

For the proposed turbines, the blades will have a total rotor diameter of 127m (Enercon 126) and 133.2 (Nordex 133). They typically turn at between 6 and 18 revolutions per minute (rpm) depending on wind speed. Start-up is generally achieved at a wind speed of around 3m/sec (measured at the hub), with optimum power generation at approximately 12 to 14m/sec. Turbine models generally shut down at wind speeds greater than 25m/sec.

Figure 2-1 Wind Park Layout.



The yaw mechanism, controlled by sensors that monitor wind direction, turns the nacelle and blades into the wind.

The towers of the turbines are conical steel columns with hub heights of 85.94 m (Enercon 126) and 83m (Nordex 133) and are delivered to site in three sections. The base of the towers is typically around 4.8m in diameter, tapering to approximately 2.2m, where it is attached to the nacelle. The turbines are accessed at the first floor, approximately 3m above ground level via an external staircase.

The first floor houses the control unit. A hatch-door provides access to the basement, where the turbine transformer is located. From the first floor, an internal ladder leads up to the nacelle.

The turbines use a direct drive system. The benefits of the direct drive include reduced mechanical stress and wearing of moving parts, less maintenance, higher level of grid compatibility, more efficient energy conversion, and lower mechanical noise emission.

The transformer in the basement of each turbine will step up the wind generated voltage to 20 to 33kV. Underground cables (maximum 33kV) will link the turbines to the proposed substation.

The wind turbines will incorporate a SCADA system that will monitor performance of the turbine. To ensure power quality, the SCADA system will monitor, control and record voltages, current and frequency. In the event that these parameters are not within specified ranges, the turbine will shut down and automatically notify the service team. The SCADA system will also permit remote monitoring of the turbine performance by the wind park operator.

The turbines will have multiple paint coats to protect against corrosion and are coloured to an off-white or light grey (battle-ship grey) finish, to blend into the skyline background. This minimises visual impact, as recommended by guidelines on wind energy development.

2.2 Turbine Foundation

The turbine foundations are cast-in-place reinforced concrete. They are typically 22m in diameter. The size of the foundation will depend on the ground conditions, wind classification for the site and the presence of groundwater. Foundation heights are approximately 2.7m high. Plates 1 to 7 below demonstrates typical turbine foundation construction sequence. Plate 1 shows the excavation of peat and overburden to a depth that allows the top of the foundation to be finished near existing ground level, which is followed by the placement of a reinforced piling platform (Plate 2). After piling, a concrete blinding layer is placed (Plate 3). The tower foundation section is then placed on the concrete blinding layer, around which the steel reinforcement is fixed (Plate 4). The formwork is then erected around the steel reinforcing and the concrete pumped into the foundation (Plate 5). The formwork is then removed and once the concrete strength is confirmed, the foundation is covered with suitable backfill material (Plates 6 & 7).

Plate 1

Plate 2

Plate 3

Plate 4

Plate 5

Plate 6

Plate 7

2.3 Internal Site Roads and Hardstanding

There will be approximately 4500 metres of access road needed to service the proposed turbines. This will generally be of conventional road construction and if considered necessary floating roads, although deep peat areas have been avoided in the wind farm layout design. Conventional roads construction will involve clearing of peat / topsoil / soft soils to the top of firm clay or dense gravel and placement of road construction material, geogrid if deemed necessary, capping layer, sub-base and running course. Floating roads will be constructed by placing geogrid reinforcement directly onto the bog surface, followed by road construction material similar to the conventional road. Staged loading will be used to allow the peat to consolidate and gain strength during floating road construction. This will be done by placing approximately 200mm capping stone layer first. The road will be lightly trafficked during this period. A second geogrid reinforcement may be used to provide additional stabilisation / strengthening of the floating road, followed by the placement of a further 200m of stone, including 2-inch down running course.

Level hardstanding areas between 2,500m^2 and 3,000m^2 will be created adjacent to each turbine location. This area will accommodate cranes during the assembly of the turbine. It will be required to meet minimum bearing capacity requirements for the cranes during lifting of turbine components. To ensure stability of the crane during lifting, the platform will be constructed by first removing the peat / soft soils and building back up to original ground level with imported stone. The area adjacent to the cranage area (assembly area) will be used for storing the turbine components prior to assembly and lifting. Access roads and hardstanding will be finished with aggregates from local quarries.

The cranage hardstands at each turbine will also be required during the operational phase of the wind farm. From time to time, cranes may be needed to replace or repair larger components, such as blades, transformers etc. It is therefore necessary to maintain the cranage hardstands for the duration of the operational phase.

Typical cranage areas and wind park access roads are shown on Plates 8 and 9 below.

Plate 8: Typical Cranage Area

Plate 9: Typical Wind Farm Access Road

2.4 Control Building

Underground 33kV cables will link the turbines to one another and from the last turbine to the substation and control building. The building will consist of an Eirgrid room, customer metering room and stores. The construction of the control room will be to Eirgrid specifications. Plate 10 shows an example of a typical wind farm control building, which will be located at Meenagrubby.

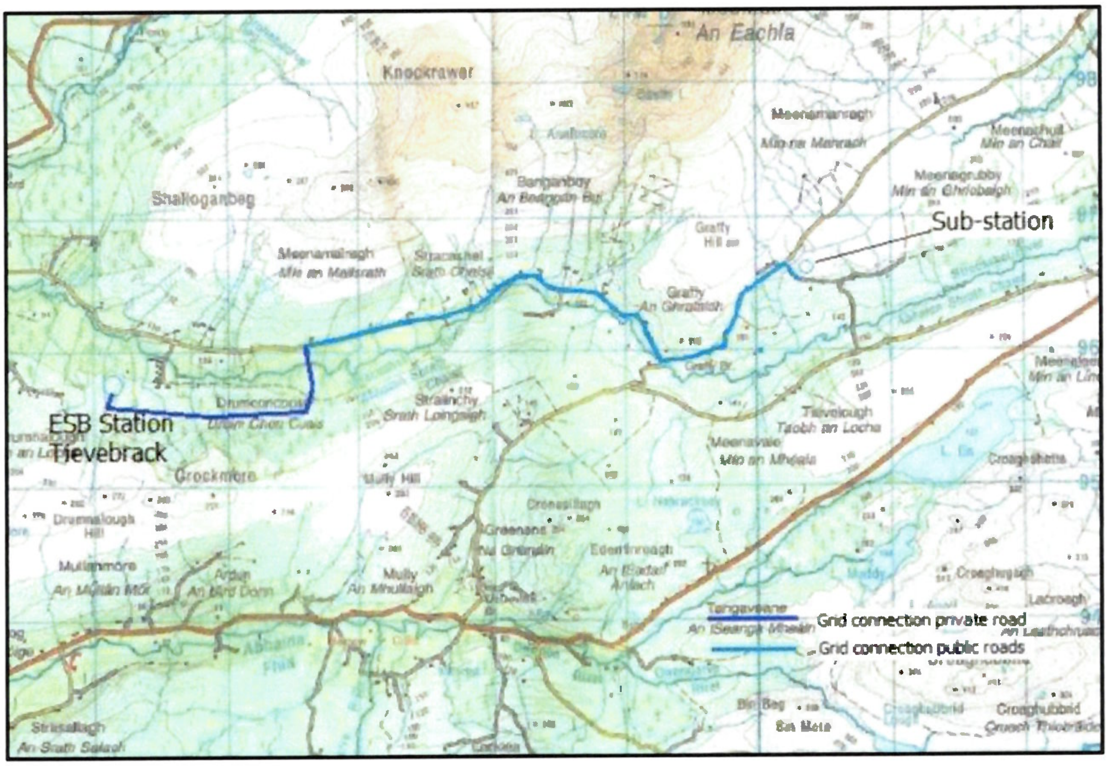
Plate 10 : Typical Wind Farm Control Buildings

2.5 Grid connection

The turbines will connect underground (33kv cables) to the proposed substation and control room and thereon to the EirGrid Tievebrack station at Drumnalough (110kv cables) and no overhead lines are proposed. At sharp bends on the grid connection route, junction boxes will be employed.

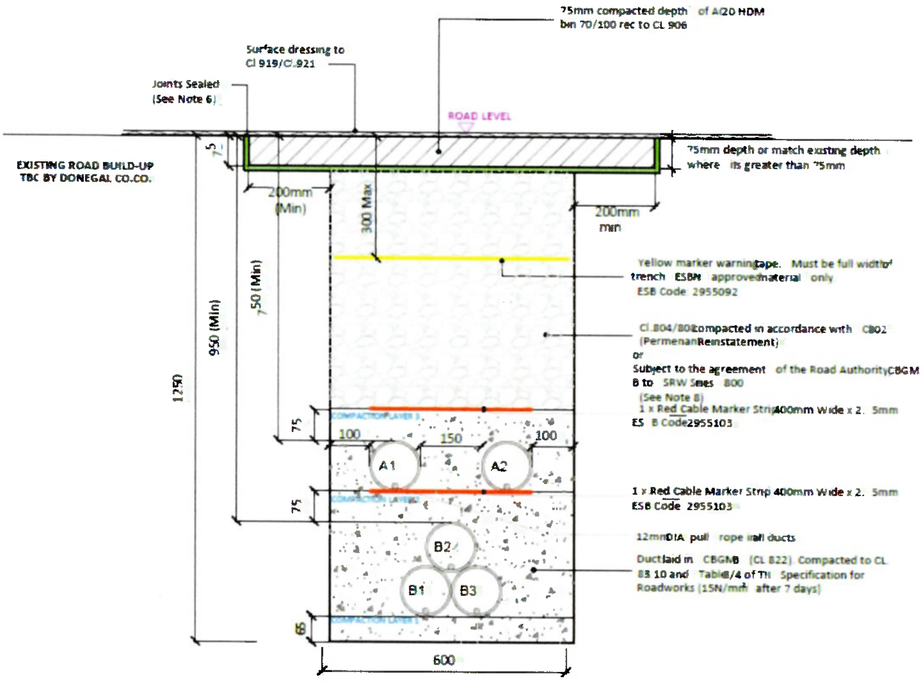
The proposed grid connection will extend for circa 7.5kms westwards from the substation/control room location at Meenagrubby, to the Tievebrack Eirgrid station at Drumnalough. For the most part the grid connection will follow the local county road, before turning into and along the private road serving commercial forestry and the Tievebrack Eirgrid station. This is shown on Figure 2-4 below.

Figure 2-4 Grid connection route.



The grid connection is likely to be constructed at the same time as the wind park and works will be carried out simultaneously at different sections of the grid connection route. The underground sections will use ducting (150mm diameter PVC ducts). Typical trench sections are shown on Plates 11 and 12 below and a detailed construction method statement for the grid connection, by TLI is set out in the Construction Environmental Management Plan (CEMP) accompanying the planning application.

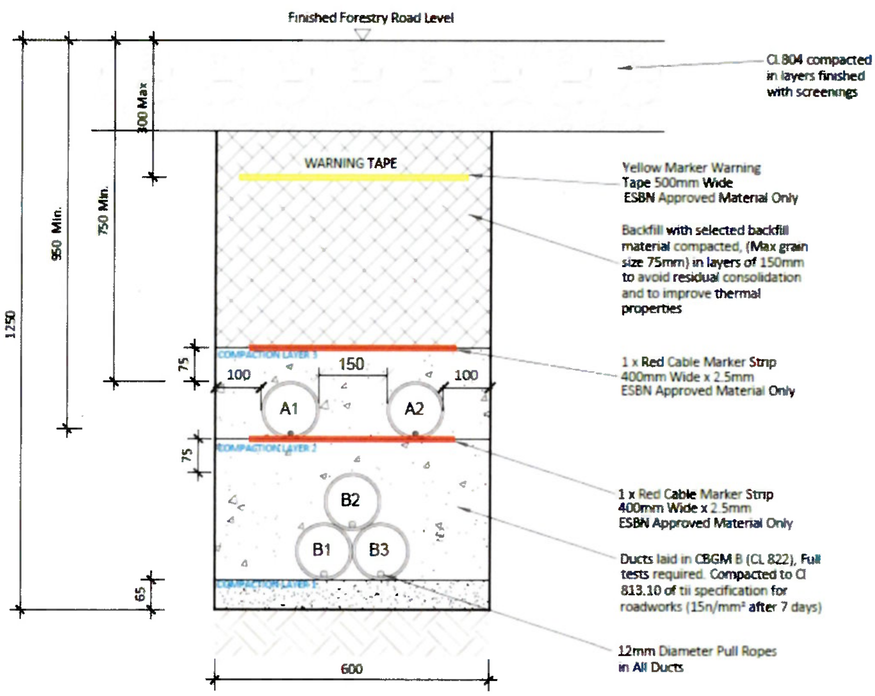
Plate 11: Typical Cable Trench Details on public road



A = 125mm Outer Diameter HDPE ESB Approved Duct SDR=17 6 [ESB Code 9317552]
B = 1 25mm Outer Diameter HDPE ESB Approved Duct SDR=17 6 [ESB Code 9317552]

Typical Section Through Permanent Rein statement of Longitudina l Opening in Dressed Rural Unbound Roadway

Plate 12: Typical Cable Trench Details on private forestry road



A = 125mm Outer Diameter HDPE ESB Approved Duct, SDR=17.6 [ESB Code: 9317552]
B = 125mm Outer Diameter HDPE ESB Approved Duct, SDR=17.6 [ESB Code: 9317552]

Typical 110kV Ducting in Forestry Road

The Meenagrubby substation will be constructed at the same time as the wind turbines and grid connection. The substation and parking area will have a total footprint area of 2887m^2.

2.6 Temporary construction compound.

A temporary construction compound extending to 1393m^2 is proposed adjacent to the proposed substation site. The location of the proposed construction compound is shown on the site layout drawing 19-014-008. The construction compound will consist of temporary site offices, staff facilities and car-parking areas for staff. Construction materials and turbine components will be transported directly to the proposed turbine locations following their delivery to the site. Temporary port-a-loo toilets located within the staff offices will be used during the construction phase, with wastewater directed to a sealed storage tank. Wastewater will be pumped out of the storage tank and taken off site by a registered waste collector to wastewater treatment plants. Water supply will come from an underground rainwater harvesting tank.

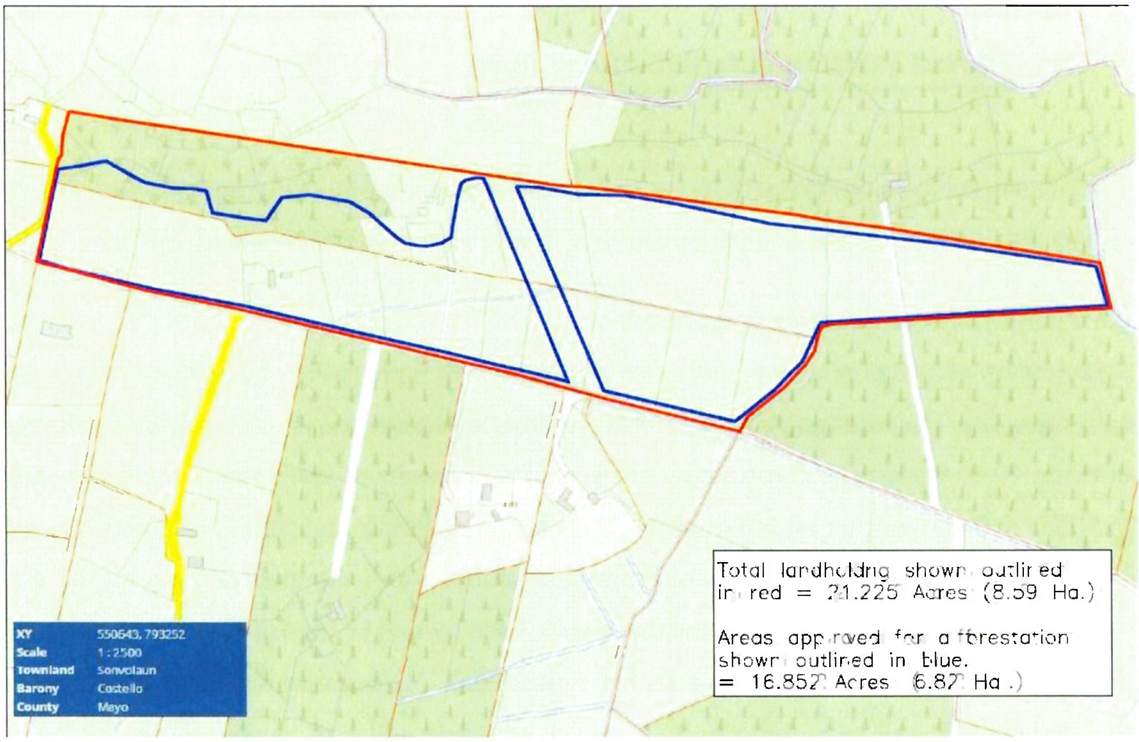
2.7 Forestry Felling

All tree felling will be undertaken under the Forestry Act 2014, using good working practices as outlined in the Forestry Regulations 2017 (S.I. No. 191 of 2017). Felling of trees, totalling 6.656 ha will be required. These are at a new road and junction widening to facilitate turbine delivery, corner widening along the delivery route, a service track through commercial forestry between turbine 4 and turbines 5/6 and mitigation felling for bats around T1, T4, T5 and T6. In terms of land use, the trees to be felled are predominantly Sitka spruce conifer plantations. A tree felling licence application will be submitted to the Forestry Service, before any felling takes place.

2.8 Forestry Replanting

To ensure compliance with the Forestry Act 2014 and the Forestry Regulations 2017, replanting of the trees felled as part of the construction of the proposed wind farm must take place. Alternative lands (8.9ha) have been acquired at Sonvolaun, Co. Mayo, of which (6.82ha) has an afforestation licence approval (see Fig. 2-4 below) These lands will be presented to the Forestry Service, as part of the tree felling licence application.

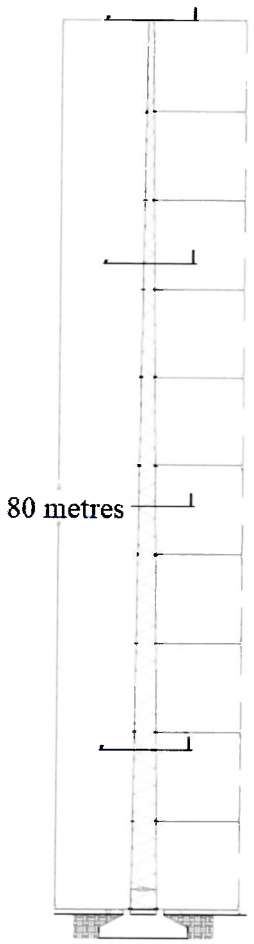
Figure 2.4: Replanting lands.

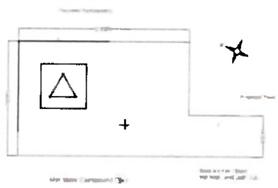


2.9 Meteorological mast

One permanent meteorological mast, 80 metres high, will be erected within the wind farm. Its location is shown on Figure 2-1 above. The mast will be equipped with wind monitoring equipment mounted at various heights. A lattice galvanised steel mast is proposed, which will have a triangular footprint with sides approximately 3m wide at the base and tapering towards the top of the mast. The mast will be anchored with a large reinforced concrete foundation approximately 10m in diameter and 2m high. The typical design of a meteorological mast is shown in Figure 2.5 below.

Figure 2.5 Meteorological mast





2.10 Upgrade works to road and culvert infrastructure

Upgrade works, such as strengthening of the soft margin, support / reinforcement to culverts along the local roads leading to the wind farm site will be required. In addition replacement of culverts along the grid connection route, apart from those watercourse crossings, which will be achieved by horizontal direct drilling (HDD) may also be carried out, depending on the stability of the existing culverts.

It is anticipated that these works will be retained, following the turbine deliveries. The works are outlined on Drawings 19-014-RW-001 to 19-014-RW-011, which are contained in Appendix 11 of Volume 3A -Appendices, of the EIAR.

3. Landscape & Visual Impact Assessment

Contents

3 Land sca pe and Visual Impact Comparison Assessment

3.1 Introduction

This comparison assessment report has been prepared to evaluate the change in landscape and visual effects which may arise as a result of the proposed optimisation of 8 turbines at the formerly permitted 13 turbine wind farm site at Graffy Wind Farm, Glenties, Co. Donegal (Donegal County Council, Pl. Ref. 09/30520, An Bord Pleanála PL.05B.237656). The existing planning permission lapsed in February 2021. However, it is considered that a comparative analysis with the recently expired permission remains still relevant, as the baseline has remained unaltered.

This comparison Landscape and Visual Impact Assessment (LVIA) will assess the likely significant effects of the Proposed Development upon the "Site" (defined as the area within the red line planning application boundary) during construction and operation.

This comparison LVIA has been undertaken in accordance with established methodology and guidance, including the Guidelines for Landscape and Visual Impact Assessment, 3rd Edition (GLVIA3), prepared by the Landscape Institute and the Institute for Environmental Management and Assessment (2013) and the Guidelines on 'The Information to Be Contained in Environmental Impact Assessment Reports', Draft, Environmental Protection Agency (August 2017).

The Proposed Development seeks to maximise the site's wind resource at this approved location with the primary aim of increasing overall energy production and output, with a reduction of turbines from 13 to 8. The Proposed Development also presents an opportunity to further harness Ireland's significant renewable energy resources and help Ireland meet 2040 targets for renewable energy.

The following supporting technical documents are included in the appendices in Appendix 2 in Volume 3 - Appendices of the EIAR:

Appendix A:

- Figure 1: Landscape Designations County Donegal
- Figure 2: Designated Walking, Cycling and Driving Routes County Donegal
- Figure 3: Designated Views and Prospects County Donegal

Appendix B:

- Map 1: Zone of Theoretical Visibility (ZTV) Map indicating areas with a theoretical view of the proposed Graffy turbines - Calculated to Hub Height (84m)
- Map2: Zone of Theoretical Visibility (ZTV) Map indicating areas with a theoretical view of the proposed Graffy turbines – Calculated to Blade Tip Height (150m)
- Map 3: Zone of Theoretical Visibility (ZTV) map indicating areas with increased theoretical visibility as a result of the proposed design change to the Graffy wind farm - Calculated to Tip Height
- Map 4: Zone of Theoretical Visibility (ZTV) map indicating areas with a theoretical view of the proposed Graffy wind farm, in combination with other relevant existing wind farms & the formerly permitted Graffy Wind Farm within the study area

Appendix C:

- LVIA Photomontage Booklet

3.2 Scope of the Assessment

The LVIA study area has been defined as 20km from the outer-most turbines (refer to Appendix A: Figures 1-3 and Appendix B: Maps 1-4 in Appendix 2 of Volume 3 - Appendices). In addition, a core study area of approximately 5km from the outer-most turbines has been used in order to focus in detail on the closest landscape and visual receptors, which have the most potential to experience significant effects as a result of the optimisation of the formerly permitted development.

This radius is informed by the formerly permitted planning application, ZTV analysis, reference to the findings of field surveys and viewpoint analysis, as well as professional experience from previous assessments. The formerly permitted turbines and operational turbines within the study area form part of the baseline and are considered in the main comparison LVIA where relevant.

The assessment of cumulative effects describes the potential combined cumulative effects of the Proposed Development in association with other relevant operational developments.

3.2.1 Description of the Proposed Development

The current proposal seeks to alter the turbine models listed in Table 1 below from the formerly permitted 13 turbine wind farm in order to maximise the site's wind resource, whilst generally retaining the formerly permitted boundary of the site and reducing the turbines within the Wind Farm to 8. In addition, underground cable connections to a proposed substation and 80-metre-high meteorological mast and strengthening of the main haul route into the site, will form part of the proposed wind farm infrastructure.

The proposed turbine models and their dimensions are listed below. However a blade diameter of 132 metres and a hub height of 84 metres, resulting in a blade-tip height of 150 metres, have been assessed to cover both wind turbine models.

Table 1: Turbine models assessed in EIAR.

Turbine Model	Hub Height	Rotor Diameter	Blade Tip Height	Blade Length
Enercon 126	85.94 metres	127 metres	149.44 metres	61.09 metres
Nordex 133	83 metres	133.2 metres	149.6 metres	64.4 metres

The location co-ordinates of the wind turbines are set out in Table 2.

Table 2: Wind Turbine Co-ordinates

No.	1	2	3	4	5	6	7	8
X	191738	190860	190657.8	190583	190210.6	190160	189747.4	189604.6
Y	398370	398240	397779.6	397297	397043.4	397408.7	396594.1	396205.3

3.2.2 Study Area

The Draft Revised Wind Energy Development Guidelines, December 2019 published by the Department of Housing, Planning and Local Government specify different standard radii for examining the Zone of Theoretical Visibility (ZTV) of proposed wind farm projects. The extent of this search area is influenced by turbine height, on the basis that taller turbines will be visible at greater distances. The search areas are 15km radius for blade tips up to 100m and 20km radius for blade tips greater than 100m.

In the case of this project, the proposed blade tips are 150m in height and therefore, the ZTV required is 20km from the outermost turbines of the scheme. This 20km radius, therefore, defines the extent of the study area for this project.

The study area of the formerly permitted Graffy Wind Farm is also used as a baseline in this ER, to allow comparison. While the wider area within 20 kilometres is referred to, the impacts of the Proposed Development will be localised in nature.

Photomontages have been produced to describe and illustrate views from representative and publicly accessible viewpoints with the majority located within a 10km study area radius.

3.3 Assessment Methodology and Significant Criteria

This section outlines the methodology used to undertake the landscape and visual assessment of the Proposed Development, and the guidance used in the preparation of each section. There are four main sections to the assessment:

- Outline of guidance followed;
- Method for compiling landscape assessment;
- Nature and visibility of the Proposed Development; and
- Assessment of potential impacts.

It should be noted that the methodology of assessing the proposed optimisation of a formerly permitted wind farm is not the same or as detailed as the methodology of assessing a new wind farm proposal. Some policies are not relevant in a comparison assessment.

3.3.1 Guidance

'Landscape and Landscape Assessment: Consultation Draft of Guidelines for Planning Authorities' (2000) recommended that all Local Authorities adopt a standardised approach to landscape assessment for incorporation into Development Plans and consideration as part of the planning process.

Although this guidance remains in draft form, this section of the ER has been broadly based on the landscape assessment guidelines presented in the DoEHLG document. A range of other guidelines also incorporated into the preparation of this landscape and visual impact assessment include:

- 'Wind Energy Development Guidelines for Planning Authorities', Department of the Environment, Heritage and Local Government, 2006;
- 'Draft Revised Wind Energy Development Guidelines', Department of Housing, Planning and Local Government, December 2019;
- 'Guidelines for Landscape and Visual Impact Assessment', The Landscape Institute/Institute of Environmental Management and Assessment, UK, 2013;
- 'Visual Assessment of Wind Farms: Best Practice', Scottish Natural Heritage, 2002;
- 'Visual Representation of Wind Farms, Version 2.2', Sottish Natural Heritage, February 2017;
- 'Assessing the Cumulative Impact of Onshore Wind Energy Developments', Scottish Natural Heritage, 2012;
- 'Visual Representation of Development Proposals', Landscape Institute, Technical Guidance Note 06/19, 17 September 2019;
- 'Siting and Designing Wind Farms in the Landscape', Scottish Natural Heritage, 2014;
- Guidelines on the information to be contained on Environmental Impact Statements, EPA, 2002.
- Advice Notes on Current Practice in the preparation of Environmental Impact Statements; EPA, 2003; and
- Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR), EPA, August 2017.

The aim of the LVIA is to identify, predict and evaluate the likely significant effects arising from the Proposed Development. Wherever possible, identified effects are quantified, in accordance with best practice guidance, but the nature of landscape and visual assessment requires interpretation by professional judgement.

In order to provide a level of consistency to the assessment, the prediction of magnitude and assessment of significance of the residual landscape and visual effects have been based on pre-defined criteria. GLVIA 3 states that 'Professional judgement is a very important part of LVIA.' (para 2.23). 'In all cases there is a need for the judgements that are made to be reasonable and based on clear and transparent methods so that the reasoning applied at different stages can be traced and examined by others.' (para 2.24). 'There are no hard and fast rules about what effect should be deemed 'significant' but LVIAs should always distinguish clearly between what are considered to be the significant and nonsignificant effects.' (para 3.32).

3.3.2 Assessment Procedures

The assessment of potential effects on the landscape character and visual amenity, although closely related, are undertaken separately. The assessment of the potential effects on the landscape is carried out as an effect on the environmental resource (i.e. the landscape). Visual effects are assessed as an interrelated effect on visual receptors.

Landscape effects derive from changes in the physical landscape which may give rise to changes in its character and how this is experienced, including consideration of landscape perception, which may in turn affect the perceived value ascribed to the landscape. Visual effects relate to changes that arise in the composition of available views as a result of changes to the landscape, to people's responses to the changes and to the overall effects with respect to visual amenity.

The significance of an effect or impact is determined by two distinct considerations:

1. The **Nature** of the receptor likely to be affected, namely

- The value of the receptor;
- The susceptibility of the receptor to the type of change arising from the Proposed Developments; and
- The sensitivity to change is related to the value attached to the receptor.

2. The Magnitude of the effect likely to occur, namely:

- The size and scale of the landscape and visual effect (for example, whether there is a complete or minor loss of a particular landscape element);
- The geographical extent of the areas that will be affected;
- The duration of the effect and its reversibility; and
- The quality of the effect – whether it is neutral, positive or negative.

Table 2 below provides the definition of the duration of both townscape and visual effects.

Table 1 Definition of Duration of Effects

Duration	Description
Temporary	Effects lasting one year or less
Short Term	Effects lasting one to seven years
Medium Term	Effects lasting seven to fifteen years
Long Term	Effects lasting fifteen to sixty years
Permanent	Effects lasting over sixty years

The quality of both townscape and visual effects is defined in Table 3 below.

Table 2 Definition of Quality of Effects

Quality of Effects	Description
Neutral	This will neither enhance nor detract from the townscape character or view
Positive (Beneficial)	This will improve or enhance the townscape character or view
Negative (Adverse)	This will reduce the quality of the existing townscape character or view

3.3.3 Landscape Effects

Landscape effects describe the impact on the fabric or structure of a landscape or landscape character.

The assessment of landscape effects firstly requires the identification of the components of the landscape. The landscape components are also described as landscape receptors and comprise the following:

- Individual landscape elements or features;
- Specific aesthetic or perceptual aspects; and

- Landscape character, or the distinct, recognisable and consistent pattern of elements (natural and man-made) in the landscape that makes one landscape different from another.

The assessment will identify the interaction between these components and the Proposed Development during construction and operational phases. The condition of the landscape and any evidence of current pressures causing change in the landscape will also be documented and described.

Landscape Value

Landscape value is frequently addressed by reference to international, national, regional and local designations, determined by statutory and planning agencies. However, absence of such a designation does not necessarily imply a lack of quality or value. Factors such as accessibility and local scarcity can render areas of nationally unremarkable quality, highly valuable as a local resource. The quality and condition is also considered in the determination of the value of a landscape. The evaluation of landscape value is undertaken with reference to the definitions stated in Table 4 below.

Table 3 Landscape Value

Landscape Value	Classification Criteria
High	Nationally designated or iconic, unspoilt landscape with few, if any, degrading elements.
Medium	Regionally or locally designated landscape, or an undesignated landscape with locally important landmark features and some detracting elements.
Low	Undesignated landscape with few if any distinct features or with several degrading elements.

Landscape Susceptibility

Landscape susceptibility relates to the ability of a particular landscape to accommodate the Proposed Development. Landscape susceptibility is appraised through consideration of the baseline characteristics of the landscape, and in particular the scale or complexity of a given landscape.

The evaluation of landscape susceptibility is undertaken with reference to a three-point scale, as outlined in Table 5 overleaf.

Table 4 Landscape Susceptibility Criteria

Landscape Susceptibility	Classification Criteria
High	Small scale, intimate or complex landscape considered to be intolerant of even minor change.
Medium	Medium scale, more open or less complex landscape considered tolerant to some degree of change.
Low	Large scale, simple landscape considered tolerant of a large degree of change.

Landscape Sensitivity

Landscape sensitivity to change is determined by employing professional judgment to combine and analyse the identified landscape value, quality and susceptibility and is defined with reference to the scale outlined in Table 6 below.

Table 5 Landscape Sensitivity to Change Criteria

Landscape Sensitivity	Classification Criteria
High	Landscape characteristics or features with little or no capacity to absorb change without fundamentally altering their present character.

Landscape Sensitivity	Classification Criteria
	Landscape designated for its international or national landscape value or with highly valued features. Outstanding example in the area of well cared for landscape or set of features that combine to give a particularly distinctive sense of place. Few detracting or incongruous elements.
Medium-High	Landscape characteristics or features with a low capacity to absorb change without fundamentally altering their present character. Landscape designated for regional or county-wide landscape value where the characteristics or qualities that provided the basis for their designation are apparent or a landscape with highly valued features locally. Good example in the area of a well-cared for landscape or set of features that combine to give a clearly defined sense of place.
Medium	Landscape characteristics or features with moderate capacity to absorb change without fundamentally altering their present character. Landscape designated for its local landscape value or a regional designated landscape where the characteristics and qualities that led to the designation of the area are less apparent or are partially eroded or an undesignated landscape which may be valued locally – for example an important open space. An example of a landscape or a set of features which is relatively coherent, with a good but not exceptional sense of place - occasional buildings and spaces may lack quality and cohesion.
Medium-Low	Landscape characteristics or features which are reasonably tolerant of change without determent to their present character. No designation present or of little local value. An example of an un-stimulating landscape or set of features; with some areas lacking a sense of place and identity.

Landscape Sensitivity	Classification Criteria
Low	Landscape characteristics or features which are tolerant of change without determent to their present character. An area with a weak sense of place and/or poorly defined character /identity. No designation present or of low local value or in poor condition. An example of monotonous unattractive visually conflicting or degraded landscape or set of features.

Magnitude of Landscape Change

Magnitude of change is an expression of the size or scale of change in the landscape, the geographical extent of the area influenced and the duration and reversibility of the resultant effect. The variables involved are described below:

- The extent of existing landscape elements that will be lost, the proportion of the total extent that this represents and the contribution of that element to the character of the landscape;
- The extent to which aesthetic or perceptual aspects of the landscape are altered either by removal of existing components of the landscape or by addition of new ones;
- Whether the effect changes the key characteristics of the landscape, which are integral to its distinctive character;
- The geographic area over which the landscape effects will be felt (within the Proposed Development site itself; the immediate setting of the Proposed Development site; at the scale of the landscape type or character area; on a larger scale influencing several landscape types or character areas); and
- The duration of the effects (short term, medium term or long term) and the reversibility of the effect (whether it is permanent, temporary or partially reversible).

Changes to landscape characteristics can be both direct and indirect. **Direct change** occurs where the Proposed Development will result in a physical change to the landscape within or adjacent to the Proposed Development site. **Indirect changes** are a consequence of the direct changes resulting from the Proposed Development. They can often occur away from the Proposed Development site (for example, off-site construction staff parking) and may be a result of a sequence of interrelationships or a complex pathway (for example, a new road or footpath construction may increase public access and associated problems e.g. littering). They may be separated by distance or in time from the source of the effects. The magnitude of change affecting the baseline landscape resource is based on an interpretation of a combination of the criteria set out in Table 7 overleaf.

Table 6 Magnitude of Landscape Change Criteria (Landscape Effects)

Magnitude of Landscape Change	Classification Criteria
None	No change.
Negligible	Little perceptible change.
Low	Minor change, affecting some characteristics and the experience of the landscape to an extent; and Introduction of elements that is not uncharacteristic.
Medium	Noticeable change, affecting some key characteristics and the experience of the landscape; and Introduction of some uncharacteristic elements.
High	Noticeable change, affecting many key characteristics and the experience of the landscape; and Introduction of many incongruous developments
Very High	Highly noticeable change, affecting most key characteristics and dominating the experience of the landscape; and Introduction of highly incongruous development.

3.3.4 Visual Effects

Visual effects are determined by the extent of visibility and the nature of the visibility (i.e. how a development is seen within the landscape); for example, whether it appears integrated and balanced within the visual composition of a view or whether it creates a focal point.

Negative visual effects may occur through the intrusion of new elements into established views, which are out of keeping with the existing structure, scale and composition of the view. Visual effects may also be beneficial, where an attractive focus is created in a previously unremarkable view or the influence of previously detracting features is reduced. The significance of effects will vary, depending on the nature and degree of change experienced and the perceived value and composition of the existing view.

Receptors

For there to be a visual impact, there is the need for a viewer. Views experienced from locations such as settlements, recognised routes and popular vantage points used by the public have been included in the assessment. Receptors are the viewers at these locations. The degree to which receptors, i.e. people, will be affected by changes as a result of the Proposed Development depends on a number of factors, including:

- Receptor activities, such as taking part in leisure, recreational and sporting activities, travelling or working;
- Whether receptors are likely to be stationary or moving and how long they will be exposed to the change at any one time;
- The importance of the location, as reflected by designations, inclusion in guidebooks or other travel literature, or the facilities provided for visitors;
- The extent of the route or area over which the changes will be visible;
- Whether receptors will be exposed to the change daily, frequently, occasionally or rarely;
- The orientation of receptors in relation to the Proposed Development and whether views are open or intermittent;
- Proportion of the developments that will be visible (full, sections or none);
- Viewing direction, distance (i.e. short-, medium- and long-distance views) and elevation;
- Nature of the viewing experience (for example, static views, views from settlements and views from sequential points along routes);

- Accessibility of viewpoint (public or private, ease of access);
- Nature of changes (for example, changes in the existing skyline profile, creation of a new visual focus in the view, introduction of new man-made objects, changes in visual simplicity or complexity, alteration of visual scale, landform and change to the degree of visual enclosure); and
- Nature of visual receptors (type, potential number and sensitivity of viewers who may be affected).

Value of the View

Value of the view is an appraisal of the value attached to views and is often informed by the appearance on Ordnance Survey of tourist maps and in guidebooks, literature or art. Value can also be indicated by the provision of parking or services and signage and interpretation. The nature and composition of the view is also an indicator. The value of the view is determined with reference to the definitions outlined in Table 8 below.

Table 7 Value of the View

Value	Classification Criteria
High	Nationally recognised view of the landscape, with no detracting elements.
Medium	Regionally or locally recognised view, or unrecognised but pleasing and well composed view, with few detracting elements.
Low	Typical or poorly composed view often with numerous detracting elements.

Visual Susceptibility

The GLVIA guidelines identify that the susceptibility of visual receptors to changes in views and visual amenity is a function of:

The occupation or activity of people experiencing the view at a particular location; and

The extent to which their attention or interest may therefore be focused on the views and visual amenity they experience at particular locations.

For example, residents in their home, walkers whose interest is likely to be focused on the landscape or a particular view, or visitors at an attraction where views are an important part of the experience often indicate a higher level of susceptibility. Whereas receptors occupied in outdoor sport, where views are not important, or at their place of work, are often considered less susceptible to change. Visual susceptibility is determined with reference to the three-point scale and criteria outlined in Table 9 below.

Table 8 Visual Susceptibility

Susceptibility	Classification Criteria
High	Receptors for which the view is of primary importance and are likely to notice even minor change.
Medium	Receptors for which the view is important but not the primary focus and are tolerant of some change.
Low	Receptors for which the view is incidental or unimportant and is tolerant of a high degree of change

Visual Sensitivity

Sensitivity to change considers the nature of the receptor; for example, a person occupying a residential dwelling is generally more sensitive to change than someone working in a factory unit. The importance of the view experienced by the receptor also contributes to an understanding of the susceptibility of the visual receptor to change as well as the value attached to the view.

A judgement is also made on the value attached to the views experienced. This takes account of:

- Recognition of the value attached to particular views, for example in relation to heritage assets, or through planning designations;
- Indicators of the value attached to views by visitors, for example through appearance in guidebooks or on tourist maps, provision of facilities for their enjoyment (sign boards, interpretive material) and references to them in literature or art; and

- Possible local value; it is important to note that the absence of view recognition does not preclude local value, as a view may be important as a resource in the local or immediate environment due to its relative rarity or local importance.

The visual sensitivity to change is based on interpretation of a combination of all or some of the criteria outlined in Table 10 overleaf.

Table 9 Sensitivity to Change Criteria

Visual Sensitivity	Classification Criteria
High	Users of outdoor recreational facilities, on recognised national cycling or walking routes or in nationally designated landscapes. Residential buildings.
Medium-high	Users of outdoor recreational facilities, in highly valued landscapes or locally designated landscapes or on local recreational routes that are well publicised in guide books. Road and rail users in nationally designated landscapes or on recognised scenic routes, likely to be travelling to enjoy the view.
Medium	Users of outdoor recreational facilities including public open space in moderately valued landscapes. Users of primary transport road network, orientated towards the Proposed Development, likely to be travelling for other purposes than just the view.
Medium-Low	People engaged in active outdoor sports or recreation and less likely to focus on the view. Primary transport road network and rail users likely to be travelling to work with oblique views of the project or users of minor road network.
Low	People engaged in work activities indoors, with limited opportunity for views of the Proposed Development.

Magnitude of Visual Change

Visual effects are direct effects as the magnitude of change within an existing view will be determined by the extent of visibility of the Proposed Development. The magnitude of the visual effect resulting from the development at any particular viewpoint or receptor is based on the size or scale of change in the view, the geographical extent of the area influenced and its duration and reversibility. The variables involved are described overleaf:

- The scale of the change in the view with respect to the loss or addition of features in the view and changes in its composition, including the proportion of the view occupied by the development;
- The degree of contrast or integration of any new features or changes in the landscape form, scale, mass, line, height, skylining, back-grounding, visual clues, focal points, colour and texture;
- The nature of the view of the Proposed Development, in relation to the amount of time over which it will be experienced and whether views will be full, partial or glimpses;
- The angle of view in relation to the main activity of the receptor, distance of the viewpoint from the development and the extent of the area over which the changes will be visible; and
- The duration of the effects (short term, medium term or long term) and the reversibility of the effect (whether it is permanent, temporary or partially reversible).

The magnitude of visual effect resulting from the development at any particular viewpoint or receptor is based on the interpretation of the above range of factors and is set out in Table 11 below.

Table 10 Magnitude of Visual Change Criteria (Visual effects)

Magnitude of Visual Change	Classification Criteria
None	No change in the existing view.
Negligible	The development will cause a barely discernible change in the existing view.
Low	The development will cause very minor changes to the view over a wide area or minor changes over a limited area.

Magnitude of Visual Change	Classification Criteria
Medium	The development will cause modest changes to the existing view over a wide area or noticeable change over a limited area.
High	The development will cause a considerable change in the existing view over a wide area or a significant change over a limited area.
Very High	The development will cause significant changes in the existing view over a wide area or a change which will dominate over a limited area.

3.3.5 Significance Criteria

The objective of the assessment process is to identify and evaluate the potentially significant effects arising from the Proposed Development. The assessment will identify the residual effects likely to arise from the finalised design taking into account mitigation measures and the change over time.

The significance of effects is assessed by considering the sensitivity of the receptor and the predicted magnitude of effect in relation to the baseline conditions. In order to provide a level of consistency and transparency to the assessment and allow comparisons to be made between the various landscape and visual receptors subject to assessment, the assessment of significance is informed by pre-defined criteria as outlined in the table below. When assessing significance, individual effects may fall across several different categories of significance and professional judgement is therefore used to determine which category of significance best fits the overall effect to a landscape or visual receptor.

The significance of the effects can be adverse (negative) or beneficial (positive) according to the definitions set out in Table 12 below.

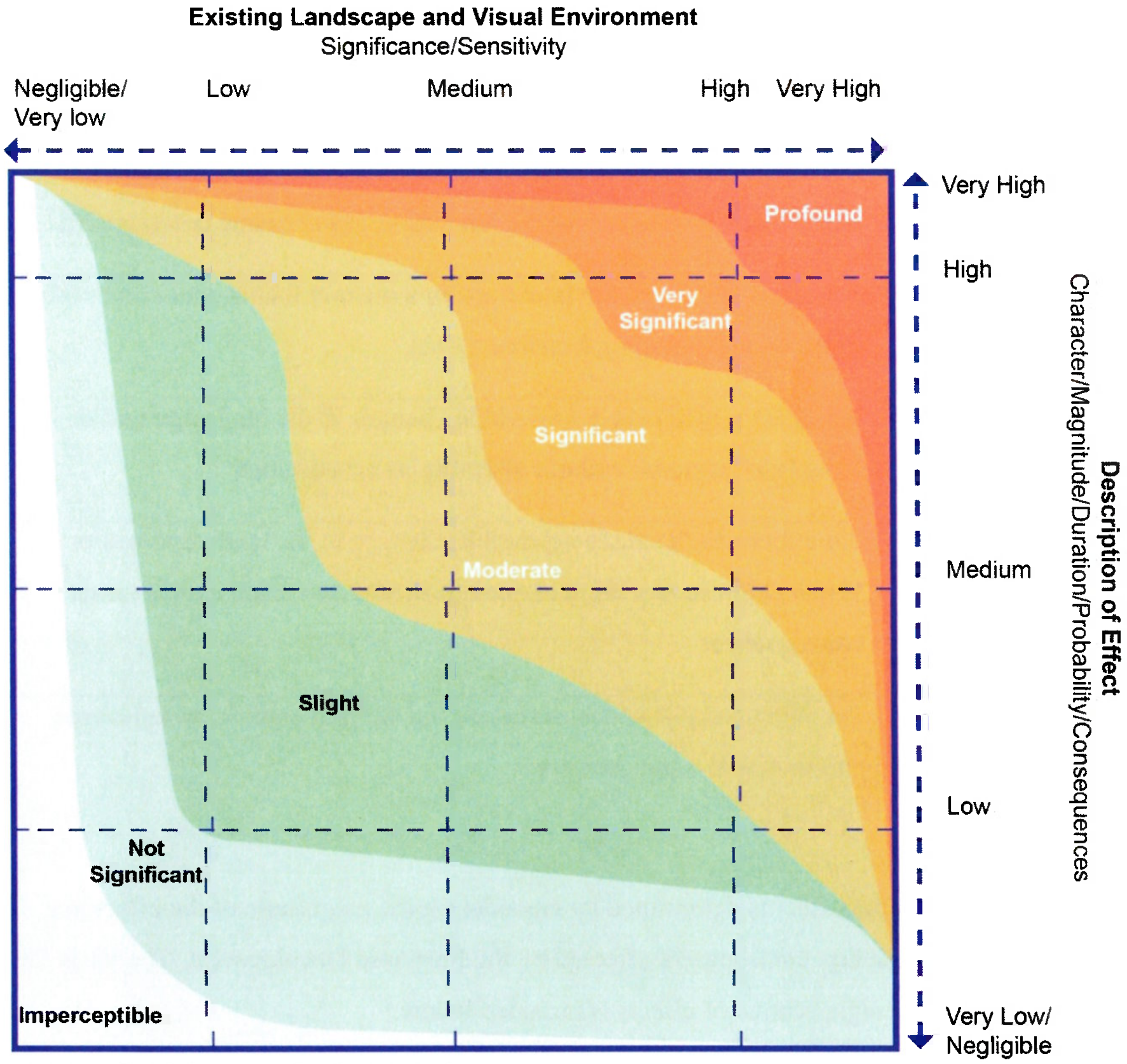
Table 11 Categories of Significance of Landscape and Visual Effects

Significance Category	Description of Effect
Profound	An effect that obliterates sensitive characteristics within the landscape and/or visual environment.
Very Significant	An effect which, by its character, magnitude, duration, or intensity significantly alters most of a sensitive aspect of the landscape and/or visual environment.
Significant	An effect which, by its character, magnitude, duration, or intensity alters a sensitive aspect of the landscape and/or visual environment.
Moderate	An effect that alters the landscape in a manner that is consistent with existing and emerging baseline trends.
Slight	An effect which causes noticeable changes in the landscape and/or visual environment without affecting its sensitivities.
Not Significant	An effect which causes noticeable changes in the landscape and/or visual environment but without significant landscape and/or visual consequences.
Imperceptible	An effect capable of measurement but without significant landscape and/or visual consequences.

The significance of the effect is determined by considering the magnitude of the effect and the quality of the baseline environment affected by the Proposed Development. The basis for consideration of the significance of effects is included below.

Effects will be assessed for all phases of the Proposed Development. Construction effects are considered to be temporary, short term effects which occur during the construction / decommission phase only. Operational / residual effects are those long-term effects, which will occur as a result of the presence or operation of the development.

The quality of each effect is based on the ability of the landscape character or visual receptor to accommodate the Proposed Development, and the impact of the development within the receiving context. Once this is done, the quality of the effect is then is assessed as being neutral, beneficial or adverse. A change to the landscape or visual resource is not considered to be adverse simply because it constitutes an alteration to the existing situation.



Adapted from *EPA Guidelines On The Information To Be Contained In Environmental Impact Assessment Reports*, August 2017

Image 1 - Basis for consideration of significance of effects

3.3.6 Cumulative Effects

In addition to landscape and visual effects, it is also important to consider potential cumulative effects. The approach used to determine cumulative effects has drawn on guidance on cumulative impact assessment published by the GLVIA3[1]. Cumulative landscape and visual effects may result from additional changes to the baseline landscape or views as a result of the Proposed Development in conjunction with other developments of a similar type and scale.

The cumulative assessment includes developments that are consented but not constructed, that are the subject of undetermined applications, or are currently at scoping which are similar in type and scale to the Proposed Development.

A list of cumulative developments has been compiled from known planning applications available on Planning Search of Donegal Council's website and known proposed public sector projects.

Magnitude of Cumulative Effects

The principle of magnitude of cumulative effects makes it possible for the proposed scheme to have a major impact on a particular receptor, while having only a minor cumulative impact in conjunction with other existing developments.

The magnitude of cumulative effects arising from the proposed scheme is assessed as **Very High, High, Medium, Low or Negligible, with intermediate categories**, based on interpretation of the following parameters:

- The additional extent, direction and distribution of existing and other developments in combination with the Proposed Development;

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1 Reference to 'Guidelines for Landscape and Visual Impact Assessment' (GLVIA), 3rd Edition, 2013, Landscape Institute (UK)

& IEMA

- The distance between the viewpoint, the Proposed Development and the cumulative developments; and
- The landscape setting, context and degree of visual coalescence of existing and Proposed Development and cumulative developments.

Significance of Cumulative Effects

As for the assessment of landscape and visual effects, the significance of any cumulative effects follows a same classification as illustrated in Image 1 - Basis for consideration of significance of effects, in Section 3.3.5 above, and will be assessed as **Profound, Very Significant, Moderate, Slight, Not Significant, Imperceptible.**

Limitations of Cumulative Assessment

The cumulative assessment focuses on potential cumulative effects relating to the main permanent structure of each cumulative development. This is due to the uncertainty of the timing of construction activities for each of the identified developments. As a result, temporary structures and activity relating to construction have not been considered within the cumulative assessment.

3.3.7 Fieldwork

Site surveys were carried out in February and September 2019. The surveys examined the potential visibility of the Proposed Development within the study area and the wider landscape, taking into account topography, existing screening vegetation and other localised factors.

3.3.8 Selection of Viewpoints

Photomontage locations used for the formerly permitted wind farm development have been reviewed, re-visited on site and assessed for their suitability for the Proposed Development.

The selection of viewpoints was carried out according to current best practice standards and the following industry guideline:

- 'Visual Representation of Development Proposals', Landscape Institute, Technical Guidance Note 06/19, 17 September 2019.

It is not feasible to take photography from every possible viewpoint located in the study area. Photography has been taken from viewpoints, which are representative of the nature of visibility at various distances and in various contexts. Viewpoint photography is used as a tool to come to understand the nature of the potential residual effects. The selection process of viewpoint locations is as follows:

- Review of viewpoints used for the formerly permitted development;
- Production of Zone of Theoretical Visibility (ZTV) mapping and comparison between the formerly permitted and the Proposed Development;
- Review of additional viewpoints capturing a wider area and different contexts of the study area via a desktop study and site surveys;
- Identification and selection of representative viewpoints showing typical open or intermittent views within a local area, which will be frequently experienced by a range of viewers; and
- Identification and selection of specific viewpoints from key viewpoints in the landscape such as routes or locations valued for their scenic amenity, main settlements etc.

3.3.9 Photomontages

Photomontages are photorealistic visualisations produced using specialist software. They illustrate the likely future appearance of the Proposed Development from a specific viewing point. They are useful tools for examining the impact of the development from a number of critical viewpoint positions along the public road network within the study area.

However, photomontages in themselves can never provide the full picture in terms of potential effects, they can only inform the assessment process by which judgements are made. A visualisation can never show exactly what the Proposed Development will look like in reality due to factors such as; different lighting, weather and seasonal conditions which vary through time and the resolution of the image. As the photomontages are representative of viewing conditions encountered, some of them may show existing buildings or vegetation screening some or all parts of the developments. Such conditions are normal and representative.

The images provided give a reasonable impression of the scale of the development and the distance to the development but can never be 100% accurate. It is recommended that decision-makers and any interested parties or members of the public should ideally visit the viewpoints on site, where visualisations can be compared to the 'real life' view, and the full impact of the Proposed Development can be understood.

The landscape and visual impact assessment on site identified a range of viewpoints located within the study area at varying distances from the Proposed Development to show the effect of the development in key close, middle and distant views.

Seven comparison photomontages and associated wireframes illustrate the difference between the formerly permitted and the proposed turbine dimensions and layout from selected viewpoints located within the study area. Depending on the availability of the exact turbine type (Enercon 126 or Nordex 133) at construction, the turbine model used in the photomontages depicts a blade diameter of 132 metres and a hub height of 84 metres, resulting in a blade-tip height of 150 metres. This will cover both turbine types. Considering the scale of either turbine, the slight differences between both turbine types will not be significant and will not alter landscape and visual effects as assessed herein.

All photomontages show the Proposed Development in good weather conditions with average cloud cover. Weather conditions will have a significant influence on visibility. In rainy or misty conditions, the wind farm may be largely indistinguishable from the general backdrop. Viewpoints / Photomontages 1-7 show the Proposed Development including the following information for each:

Page 1

Existing View - Showing the baseline image only; and

Wireframe View - Showing all visible elements of the Proposed Development (blue colour) and the Formerly Permitted Development (red colour) including all visible components in a model image based on wirelines.

Page 2

Comparison Photomontage - Showing all visible elements of the Formerly Permitted Development superimposed into the existing view; and

Comparison Photomontage - Showing all visible elements of the Proposed Development superimposed into the existing view.

Photomontage images have been produced with reference to best practice and the following industry guidelines:

- 'Visual Representation of Development Proposals', Landscape Institute, Technical Guidance Note 06/19, 17 September 2019;
- Guidelines for Landscape and Visual Impact Assessment (GLVIA), Third Edition, Landscape Institute and Institute of Environmental Management and Assessment, IEMA, 2013; and
- Visual Representation of Wind Farms, Version 2.2, Scottish Natural Heritage, February 2017 (in relation to viewpoint selection, technical equipment, function and limitations of visualisations).

3.3.10 Zone of Theoretical Visibility (ZTV)

A computer automated study of the Zone of Theoretical Visibility (ZTV) has been carried out to identify the 'theoretical' extent and degree of visibility of the proposed taller turbines and the difference between the visual extent between the formerly permitted and Proposed Development. This theoretical exercise is based on contour lines with an interval of 10m. It does not allow for intermittent screening provided by, for example, hedgerows, forests or buildings and does not involve the actual height of crests (but using the nearest 10m contour below). Therefore, the ZTV map, assuming no screening, represents a 'worst-case-scenario' with respect to viewing exposure. For the purposes of this project a radius of 20km was used for the ZTV.

The most relevant aspect of ZTV mapping for this assessment is the potential increase in visual exposure of the proposed taller turbines and their altered location when compared to the lower formerly permitted turbines and whether new visual receptors are potentially affected, which would not currently have a view of the formerly permitted scheme but might have a view of the proposed turbines. Areas with increased theoretical visibility as a result of the proposed design change to the formerly permitted Graffy Wind Farm has been indicated in the ZTV Maps 1-4 accompanying this assessment (refer to Appendix B in Appendix 1 of Volume 3).

As for the photomontages (refer to Section 3.3.9 above), depending on the availability of the exact turbine type (Enercon 126 or Nordex 133) at construction, the turbine dimensions used in the ZTV mapping depict a blade diameter of 132 metres and a hub height of 84 metres, resulting in a blade-tip height of 150 metres. This will cover both turbine types. Considering the scale of either turbine type, the slight differences between both turbine types will not lead to significant changes in their visibility as depicted in the ZTV mapping.

Limitations of ZTV Mapping

The Scottish Natural Heritage (SNH) guidelines provide useful information in reference ZTV mapping and the capabilities of theoretical visibility mapping:

- *The ZTV usually presents a 'bare ground' scenario, i.e. visibility of the Proposed Development in a landscape without screening structures or vegetation. This includes trees, hedgerows, buildings and small-scale landform or ground surface features. The ZTV also does not take into account the effects of weather and atmospheric conditions, and therefore can be said to represent a 'worst-case' scenario, that is where the wind farm could potentially be seen given no intervening obstructions and favourable weather conditions.*
- *The ZTV indicates areas from where a wind farm may be visible, but cannot show how it will look, nor indicate the nature or magnitude of visual impacts. The visibility of the turbines will decrease with the distance from which they are viewed, but this is not accounted for in the ZTV.*
- *A ZTV is only as accurate as the data on which it is based. It is not easy to test the accuracy of a ZTV in the field, although some verification will occur during the assessment of viewpoints.*
- *In order to handle large areas of terrain, the DTM data is based on information that does not allow detail to be distinguished below a certain level. There are also differences in the way that the software package 'interpolates' between heights in the calculations made.*

3.4 Legislation and Policy Context

3.4.1 DoEHLG 'Wind Energy Development Guidelines' (2006)

The Department of the Environment, Heritage and Local Government's 'Wind Energy Development Guidelines' (DoEHLG, 2006) provide advice to Planning Authorities on planning for wind energy developments through the Development Plan process and in determining applications for planning permission. The guidelines are also intended to be of assistance to developers and the wider public in considering wind energy development.

Chapter 6 of the DoEHLG guidelines provides guidance in relation to the siting and design of wind energy developments in the landscape. The guidelines state that landscape character types provide a useful basis for the practical application of siting and design guidelines in relation to wind energy development. The following six landscape character types were selected to represent most situations:

- Mountain moorland,
- Hilly and flat farmland,
- Flat peatland,
- Transitional marginal land,
- Urban/industrial settings; and
- Coast.

Of these landscape character types, the type most closely represented by the area in which the Proposed Development site is located is 'Transitional marginal land'.

The DOEHLG guidelines state that key characteristics of this landscape are:

- "Comprises something of both mountain moorland and farmland, thus involving a mix of small fields, tight hedgerows and shelterbelts;
- May include relatively rugged and rocky terrain, and thus a reasonable degree of spatial enclosure;

- Higher ground tends to be wet and boggy. Lower areas are usually cultivated and managed as fields; and
- Houses and farmsteads are usually fairly common; and this landscape type bridges the organized and intensively managed farmland and the more naturalistic moorland".

Guidance in relation to location, spatial extent and scale, spacing, layout, height and cumulative effect is provided in the DoEHLG guidelines for each landscape character type. These guidelines have been considered through the site design process for the Proposed Development. The guidelines for transitional marginal land are presented in Section 10.5.2.1 below.

Siting and Design Guidance for Transitional Marginal Land

Location

The DoEHLG guidelines state that *"as wind energy developments, for reasons of commercial viability, are typically located on ridges and peaks, a clear visual separation will be achieved from the complexity of lower ground. However, the guidelines go on to state that 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 minimize visual confusion such as the crossing by blade sets of skylines, buildings, utility lines and varied landcover".*

Spatial Extent

"Spatial extent is the area covered by a wind energy development, reflecting the number of turbines involved and their spacing". The DoEHLG guidelines state that *"the spatial extent of a wind energy development should be balanced and in scale with its landscape context".* With regard to transitional marginal landscapes it is stated that *"Wind energy developments in these areas 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".*

Spacing

The DoEHLG guidelines state that *"all options are possible, depending on the actual landscape characteristics. However, irregular spacing is likely to be most appropriate, given* *the complexity of landform and land cover typical of these landscapes, and the absence of extensive swaths of fields of regular and rectilinear pattern".*

Layout

The guidelines state that *"the likely location of wind energy developments on ridges suggests a linear or staggered linear layout whereas on broader hilltops they could be linear or clustered. Grid layouts are less likely to succeed aesthetically unless there is an open continuity of similar landcover".*

Height

The guidelines state that *"in small-scaled enclosed areas, short turbines are preferred in order to avoid their spatial dominance and to ensure visual balance. However, the guidelines also state that where the upper ground is relatively open and visually extensive, taller turbines may be more appropriate. In terms of perceived height, the profile can be even or uneven, depending on the profile and visual complexity of the terrain involved. The more rugged and undulating, the greater the acceptability of an uneven profile provided it does not result in significant visual confusion and conflict".*

Cumulative Effect

The DoEHLG guidelines state that cumulative effects *"would have to be evaluated on a case-by-case basis, but 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".*

It should be noted that the Draft Revised Wind Energy Development Guidelines (December 2019) are currently in consultation process. The above statements taken from the still current 2006 guidelines remain the same in the draft 2019 guidelines as of February 2021.

3.4.2 Wind Energy and Landscape Policies and Objectives

Donegal County Development Plan 2018-2024 sets out an overall strategy for the proper planning and sustainable development of the administrative area of Donegal County Council.

Chapter 8 of the Plan outlines policies and objectives relating to wind energy developments. The development plan identifies areas which are considered suitable for wind energy development in the county and was based on information including potential for wind energy, existing and proposed grid connection, natural heritage designations and landscape sensitivity.

The following order was made based on a judicial review re certain elements of the wind energy policy in 2018:

"By Order made on the 5th day of November, 2018, in proceedings bearing Record Number 2018/533JR between Planree Limited, Applicant and Donegal County Council, Respondent, certain provisions of the County Donegal Development Plan 2018-2024, being Section 6.5(c) and (f) of the Wind Energy standards at Part B: Appendix 3, Development Guidelines and Technical Standards and Map 8.2.1 as contained in the County Donegal Development Plan 2018-2024 as published were ordered to be deleted and/or removed from the County Donegal Development Plan 2018-2024. The Development Plan should be read in light of the Order in question pending any possible future variation of same."

Part B, Appendix 3, Sections 6.5c and 6.5f in Appendix 1 of Volume 3 states the following:

- Section 6.5c: Areas identified as locations where wind farm development would not be acceptable as identified on map 8.2.1, chapter 8 of the County Development Plan 2018-2024.
- Section 6.5f: A setback distance of ten times the tip height of proposed turbines from residential properties and other centres of human habitation.

3.4.3 Landscape Policies and Objectives

Chapter 7 of the Donegal County Development Plan 2018 - 2024 sets out policies and objectives regarding the natural and built heritage. The Plan acknowledges the European Landscape Convention, which was ratified by Ireland, which requires commitment to introducing policies regarding the protection, management and planning of landscapes. The Plan also refers to the Draft Guidelines on Landscape and Landscape Assessment, and the National Landscape Strategy for Ireland 2015-2025. It is noted that the Strategic

Environmental Assessment (SEA) for the Plan recommends the preparation of a Landscape Character Assessment for County Donegal, which is now complete and adopted.

The protection of sensitive landscapes from unsuitable developments is seen as one of the Council's most important roles. The Plan describes the 3 layers of Landscape Value which have been classified as the following areas, which are mapped on Map 7.1.1 of the Development Plan:

*"**Areas of Especially High Scenic Amenity (EHSA)** are sublime natural landscapes of the highest quality that are synonymous with the identity of County Donegal. These areas have extremely limited capacity to assimilate additional development".*

*"**Areas of High Scenic Amenity (HSA)** are landscapes of significant aesthetic, cultural, heritage and environmental quality that are unique to their locality and are a fundamental element of the landscape and identity of County Donegal. These areas have the capacity to absorb sensitively located development of scale, design and use that will enable assimilation into the receiving landscape and which does not detract from the quality of the landscape, subject to compliance with all other objectives and policies of the plan".*

*"**Areas of Moderate Scenic Amenity (MSA)** are primarily landscapes outside Local Area Plan Boundaries and Settlement framework boundaries, that have a unique, rural and generally agricultural quality. These areas have the capacity to absorb additional development that is suitably located, sited and designed subject to compliance with all other objectives and policies of the Plan".*

The Development Plan states also that *"within each of the landscape classifications detailed above (EHSA, HSA and MSA) and along the interface between the designations there may be areas that do not fully meet the definition of the designation. Such anomalies in landscape designation shall be considered individually and in the context of all other objectives and policies contained within [the Development Plan], should an application for development be submitted in these areas (excluding wind energy proposals or ancillary works). The onus shall be on the applicant to demonstrate that the site within which it is situated does not meet the characteristics of the landscape within which it is situated and that any development applied for shall not adversely affect the classification and value of the wider landscape".*

None of the landscapes of County Donegal have been classified as Low Value.

The formerly permitted Graffy Wind Farm and the Proposed Development are located within an area of Especially High Scenic Amenity (EHSA).

The Donegal County Development Plan 2018-2024 sets out policies and objectives for landscape conservation as follows:

NH-0-4: *To ensure the protection and management of the landscape in accordance with current legislation, ministerial and regional guidelines and having regard to the European Landscape Convention 2000.*

NH-0-5: *To protect, manage and conserve the character, quality and value of the landscape having regard to the proper planning and development of the area, including consideration of the scenic amenity designations of this plan, the preservation of views and prospects and the amenities of places and features of natural, cultural, social or historic interest.*

NH-O-8: *To ensure where appropriate the protection and conservation of hedgerows, stone walls and traditional field boundaries as natural heritage corridors and migration routes for wildlife where they are shown to play a significant heritage role*

NH-P-8: *It is the policy of the Council to safeguard the scenic context, cultural landscape significance, and recreational and environmental amenities of the County's coastline from inappropriate development.*

NH-P-9: *It is the policy of the Council to manage the local landscape and natural environment, including the seascape, by ensuring any new developments do not detrimentally impact on the character, integrity, distinctiveness or scenic value of the area.*

NH-P-10: *It is the policy of the Council to manage the local landscape and natural environment, including the s eascape, by ensuring any new developments do not detrimentally impact on the character, integrity, distinctiveness or scenic value of the area.*

NH-P-13: *It is a policy of the Council to protect, conserve and manage landscapes having regard to the nature of the Proposed Development and the degree to which it can be accommodated into the receiving landscape. In this regard the proposal must be considered in the context of the landscape classifications, and views and prospects contained within this Plan and as illustrated on Map 7.1.1: 'Scenic Amenity'.*

NH-P-14: *It is a policy of the Council to protect the character of the following approach roads to Glenveagh National Park:*

- *Glendowan to Doochary Road.*
- *Dunlewey to Termon Road.*
- *Churchill to Termon/Dunlewy Road.*
- *Muckish Gap to Cabiber Bridge.*

NH-P-15: *It is a policy of the Council to safeguard prominent skylines and ridgelines from inappropriate development.*

NH-P-16: *It is a policy of the Council to protect and enhance the landscape character, culture and heritage of the Islands whilst facilitating appropriate development. All development must be considered in the context of the landscape classification contained within this Plan and as illustrated on Map 7.1.1: Scenic Amenity.*

3.4.4 Views and Prospects

Map 7.1.1 of the current County Development Plan includes a map of views and prospects. The Plan states in Policy NH –0-8 and NH P – 13 that in seeking to preserve views and prospects, particular attention will be paid to views between public roads and sea, lakes and rivers.

NH-O-7: *To protect the areas of Especially High Scenic Amenity from intrusive and/or unsympathetic developments.*

NH-P-6: *It is a policy of the Council to protect areas identified as Especially High Scenic Amenity on Map 7.1.1: 'Scenic Amenity'. Within these areas, only developments assessed to be of strategic importance or developments that are provided for by policy elsewhere in this Plan shall be considered.*

NH-P-8: *It is the policy of the Council to safeguard the scenic context, cultural landscape significance, and recreational and environmental amenities of the County's coastline from inappropriate development.*

NH-P-13: *It is a policy of the Council to protect, conserve and manage landscapes having regard to the nature of the Proposed Development and the degree to which it can be accommodated into the receiving landscape. In this regard the proposal must be considered* *in the context of the landscape classifications, and views and prospects contained within this Plan and as illustrated on Map 7.1.1: 'Scenic Amenity'.*

NH-P-17: *It is a policy of the Council to seek to preserve the views and prospects of special amenity value and interest, in particular, views between public roads and the sea, lakes and rivers. In this regard, development proposals situated on lands between the road and the sea, lakes or rivers shall be considered on the basis of the following criteria:*

- *Importance value of the view in question.*
- *Whether the integrity of the view has been affected to date by existing development.*
- *Whether the development would intrude significantly on the view.*
- *Whether the development would materially alter the view.*

In operating the policy, a reasonable and balanced approach shall be implemented so as to ensure that the policy does not act as a blanket ban on developments between the road and the sea, lakes and rivers.

The views and prospects located within the study area are indicated on Figure 3, which is included in Appendix A and further described in Section 3.6.3 herein.

3.4.5 Walking, Driving and Cycling Routes

Table 13.3 of the County Development Plan lists a number of walks and trails within County Donegal. Walks within the study area are listed in the Visual Receptor section below. There are also a number of driving and cycling routes located within the study area. Relevant routes included in the assessment are indicated on Figures 2 and 3 (refer to Appendix A in Appendix 1 of Volume 3).

3.5 Existing Landscape Context (Receiving Landscape)

The site is located approximately 9km east, northeast of Glenties in County Donegal. It lies to the north of the R253 Regional Road that connects to the R252 and Glenties with Ballybofey to the east. Direct access to the site is provided by a network of local roads. The area is characterised by mountainous terrain intersected by river valleys.

The site lies on the foothills of Aghla Mountain (589 OD), which forms the northern boundary. Croveenananta (476 OD) lies to the south with Boultypatrick (429 OD) to the east and Derkbeg Hill (332 OD) to the west. The site slopes from north to south crossing the valleys formed by the Stracashel, Stranagoppoge and Owenea Rivers. It varies in elevation from 120m OD to 310 m OD. The site is drained by a number of streams that discharge into the rivers. The land uses range from rough grazing with some conifer plantations and commercial peat cutting.

The settlement pattern is generally dispersed with isolated houses/farmsteads along the foothills. More concentrated development is found in the lower Stracashel valley to the east and west of Graffy Bridge, on the lower slopes of Mully Hill and at Greenans to the south. The settlement pattern from Glenties towards Edenfinreagh is dominated by single houses on the northern side of the regional road. There is a school, church and public house adjacent to the village. Extending eastwards along the R253 there is a general absence of residential development until the village of Commeen is reached.

3.5.1 Landscape Character Assessment County Donegal

Landscape character across the study area is defined at the County level by the 'Landscape Character Assessment of County Donegal' (DCC, 2015) ('LCACD').

The Site and the majority of the study area is located within landscape character area (LCA) 38: Bluestack as defined by the LCACD. The key characteristics of LCA 38: Bluestack are:

Landform and Land Cover:

- *High mountainous upland hard rock area with an underlying geology of quartzite along the north, granite to the east and a schist band though the centre. Breccia, a composition unique to the area, underlies the southern area of the Bluestacks.*
- *Loughs of various sizes are nestled among the Bluestack Mountains and Tawnawully Mountain, and rivers rising in the uplands flow through valleys carved from the rocks in all directions out of this upland area.*
- *Much of the upland landcover is thin peat and exposed rock whilst the river valleys and lower slopes have marshy areas and deeper peat soils, some of which have been improved for farming over the years.*

- *The Owenea River flows west through a large, flat, broad, agricultural valley in the west of the LCA towards Glenties. Large square, hedgerow bound fields define this section of the LCA contrasting with the predominant upland bog landscape type.*
- *A patchwork of coniferous forestry plantations at various stages of growth cover the lower mountain slopes throughout the area.*
- *Dispersed scatter of one-off residential dwellings and isolated farmsteads throughout the area but concentrated in the west.*

Settlements:

There are no settlements within this LCA.

History, Culture and Heritage:

- *Within the Gaeltacht.*
- *There are a number of Recorded Monuments within this LCA including a fortified island cashel on Lough Anna in the North West and other isolated archaeological monuments on lower lying lands around the periphery of the LCA.*
- *Important vernacular and imposed built heritage including 3 NIAH structures.*
- *The Historic Landscape Characterisation maps the majority of this landscape as 'Open upland rough ground' (with frequent small lakes). Blanket bog covers the lower slopes to the north, west and east.*
- *Historically the area has been used for extensive rough grazing, with very low stocking levels.*

Access and Recreation:

- *The N15, Letterkenny to Donegal Town road crosses south west through the eastern edge of this LCA, whilst the R250 Glenties to Letterkenny road travels through this area along an east-west axis.*

- *Numerous walking trails and marked ways through this LCA offer extensive and panoramic views out over the area (some to sea) and the surrounding Donegal landscape.*
- *The many mountain lakes and rivers in this area offer excellent fishing; the Owenea River is one of the best salmon rivers in the County.*
- *Iconic mountain landscape framing views into the landscape and offering unobstructed views from the area, many from existing paths and roadways.*

Biodiversity:

- *Ecologically important landscape containing 5,827ha of Natura 2000 sites (SAC & SPA), 200.9ha of NHA sites and 5,231 of pNHA sites.*
- *A portion of this LCA is a catchment area for the Fresh Water Pearl mussel (FWPM) and the Owenea River has significant adult and juvenile populations.*
- *The river valleys and tributaries constitute important biodiversity links along with the hedgerow lined fields, roads, lanes and pathways.*

Forces for change are identified as:

- *Wind farms*
- *One off residential dwelling's*
- *Afforestation/deforestation*

Other LCAs within the study area are illustrated in Figure 1 (refer to Appendix A in Appendix 1 of Volume 3). It is envisioned that there will be no significant adverse impact on the neighbouring LCA's due to effects of distance and intervening building structures, vegetation and topography.

3.5.2 Views towards the Site

The formerly permitted development is visible from the surrounding areas, particularly in a south-western to north-eastern corridor defined by the mountainous topography. There are few farms and dwellings along the network of local roads in the lowlands, however other wind farms and overhead telecommunication and local electricity distribution lines are scattered within the wider rural landscape.

Seven photomontages have been produced from representative viewpoints located within the study area to illustrate and assess the visibility of the proposed optimisation of Graffy Wind Farm. During the consideration of views towards the site, particular attention was paid to the surrounding road network and residences located along these roads. The description and analysis of each individual photomontage is presented in Section 3.6.8 of this ER.

3.6 Comparison Assessment

3.6.1 'Do-Nothing' Scenario

All components of the environment are constantly changing due to a combination of natural and human processes. When predicting likely direct and indirect effects it is important to remember that there are two available for comparison: the existing environment and the environment as it will be in the future if no development of any kind were to take place – the 'do nothing ' impact.

In landscape terms, if the Proposed Development does not go ahead, the proposed site would likely remain unchanged apart from natural changes or may be used for commercial forestry as this is a pattern in the wider area. As there is a lapsed planning permission (lapsed in February 2021) for a 13 turbine wind farm (Donegal County Council, Pl. Ref. 09/30520), there will be development pressure for wind farm applications in this area.

3.6.2 ZTV Study

The following key points should be noted from the comparative ZTV study (refer to Appendix B, Maps 1 - 4 in Appendix 1 of Volume 3):

- The differential ZTV mapping (refer to Maps 3 and 4, as included in Appendix B) indicates that only a limited proportion of the study area that did not previously afford theoretical views of the formerly permitted wind farm, would afford views of the taller proposed turbines. Areas of additional visibility are located in elevated locations, primarily to the north, often without access to the general public and without residential dwellings. However, lower ground areas including residential receptors in the vicinity of Fintown and Glashagh will likely experience visibility of blade sections, which were not visible under the formerly permitted scheme.

- The increased visual exposure is distributed throughout the study area in small sections, with the greatest concentrated increase in theoretical visibility experienced within 5-15km to the north of the wind farm site in the Glendowan Mountain range and associated slopes and upland valleys.

3.6.3 Scenic Views and Prospects

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, guide books, road side rest stops or on post cards that represent the area. In this instance the only recognised scenic routes and views were found to be contained in the Donegal County Development Plan.

Donegal County Development Plan 2018-2024

Designated scenic views and prospects are indicated on Map 7.1.1 of the County Development Plan. They have been replicated for the purpose of this comparison assessment in Figure 3 (refer to Appendix A in Appendix 1 of Volume 3). The direction of scenic views and prospects have been illustrated with directional arrows.

The majority of scenic views and prospects located within the study area are facing away from the Proposed Development site or intervening landform will fully screen views of the Proposed Development. The closest cluster of scenic views and prospects are located to the east of the Proposed Development along the R253. They focus away from the Proposed Development to the south and southwest towards the Bluestack Mountain Range. The closest protected scenic views and prospects to the north of the Proposed Development are located along the R252 and include views southeast across Lough Finn. The majority of these views will remain unaffected by the Proposed Development due to the intervening Aghla Mountain and its foothills further east. However, there is a possibility for tip height visibility of up to two turbines from sections of the R250 and R250 in the vicinity of Fintown as indicated in Appendix B, Map 2.

There are views of scenic quality located within Glenveagh National Park, located at the cusp of the 20km study boundary, due to distance and intervening landform it is envisioned there will be no significant change in available views.

3.6.4 Walking, Cycling and Driving Routes

Recreational receptors are considered to have a value and susceptibility to change based on the degree to which views of the landscape are important. Views from long distance walking and cycling routes are considered to have both a High value and their users are considered to have High susceptibility to change (High sensitivity overall).

Wild Atlantic Way

The Wild Atlantic Way is tourism trail located along the West Coast of Ireland. Sections of the route sit to the west of the site, within the 20km study area. Following the ZTV mapping, theoretical visibility of the Proposed Development has been ruled out for the majority of the route.

Theoretical visibility was indicated on the ZTV mapping along a section of the Wild Atlantic Way, north of Ardara from the R261. During the site investigation, this route was driven, and the Proposed Development was deemed to be mostly screened by intervening landform and vegetation. However, at Owenea River Bridge there is a slightly elevated viewpoint where an open view of the Proposed Development will be possible. At this point there is an unobstructed view to the east, including the slightly lower lying land to the north east where the Proposed Development sits. The Proposed Development can be partially seen from this point in the far distance, with the nature of visibility relating to the varying visibility of upper parts of five of the proposed turbines, which is a slight increase from that of the formerly permitted development. The Proposed Development will generate a slight intensification of wind farm infrastructure in the landscape, when compared to the formerly permitted development as illustrated in Viewpoint 6 (Page 1&2) as contained in Appendix C in Appendix 2 of Volume 3 of the EIAR.

As a road user traveling along the Wild Atlantic Way, the views are predominately focused on dramatic coastline present along this route. Given the distance of the Proposed Development from the route, the nature of this particular tourist trail, and the changes between the Proposed Development and formerly permitted development, it is deemed the significance of effects on the Wild Atlantic Way is considered Not Significant-Slight Neutral.

Bluestack Way

The Bluestack Way is a 65km walking trail through the Bluestack Mountain Range, located to the south and south west of the Proposed Development. Additional theoretical visibility of the Proposed Development is illustrated on the ZTV mapping on a section of this route, west of Glenties, with a section of additional visibility introduced as a result of the proposed optimisation of the Graffy Wind Farm site. Given the limited changes in visibility when compared with the formerly permitted development, the significance of effects on the Bluestack Way is considered Not Significant Neutral.

Sli na Finne

Sli na Finne is a 42km walking trail through the mountains of central Donegal, located to the east and north of Proposed Development. Viewpoint 3 is located along this walking route, on the R253 and is representative of views from along this section of the route. At this location, both the formerly permitted and Proposed Development will be visible and clearly perceived by receptors. While the increased height of the proposed turbines will lead to a slightly more prominent presentation of the development in the landscape, overall there will not be a significant increase in effects. In terms of the wider route within the study area, the Proposed Development will lead to pockets of additional visibility along this walking route to the north and north east, as illustrated on ZTV Map 3 (refer to Appendix B). The significance of effects are considered Slight Neutral.

3.6.5 Effects at Construction

Effects arising from the process of construction of the Proposed Development are considered to be of a similar nature and duration to those arising from the Formerly permitted Development and therefore have not been considered in further detail within this assessment.

Generally, construction effects will be temporary, short term effects which occur during the construction phase only. Areas experiencing visual effects during the construction stage will vary considerably, depending on the active construction phase.

Landscape and visual effects during the construction stage will be experienced at the location of the proposed wind turbines and met mast as well as their surroundings due to earth works, foundation works, construction of access roads and construction of wind turbine and met mast structures. Construction works will also include the installation of underground cables from the turbine / met mast locations to the nearest local road as well as along existing local roads (mainly L7593) and access tracks to the existing EirGrid Tievebrack Substation located approximately 3km northeast of Glenties. Construction works will also be experienced at the proposed substation location and along the local road network where construction traffic will travel. The effects arising during construction will result from machinery, personnel, excavations, traffic and material movements. Landscape and visual effects will be highest within approximately 500m radius from the Proposed Development site boundary where open or partial views of the construction works become possible. The visibility of construction works within the wider study area (beyond approximately 500m from the Proposed Development site boundary) will depend on the location of the observer and the extent of intervening topography and vegetation. It will include sections of wind turbines and the met mast, sections of the proposed substation and machinery (for example cranes, cable laying machines or other moving construction traffic) and material storage areas.

The majority of receptors will be local residents and visitors driving through the study area within approximately 500m from the Proposed Development site boundary. Residential receptors are considered to have a highest sensitivity to visual or landscape changes as they will experience changes in views on a daily basis. The magnitude of landscape and visual effects is considered to range from medium to high and their significance will range from moderate to very significant adverse, particularly from locations adjacent to the construction works. However, considering the undulating landscape with steep slopes, open views of construction works will be limited to local areas. Middle distance views and long distance views of the construction works will mainly be possible during the assembly of the wind turbines, the met mast and substation components. Visibility will increase with the increasing height of the proposed structures and relevant assembly machinery required. The extent of views of machinery (cranes) required, in particular in relation to wind turbine and met mast assembly, will be similar to the theoretical visibility indicated at 84m hub height, refer to Map 1, as included in Appendix B. The magnitude of landscape and visual effects is considered to range from Low to Medium. The significance will range from Slight to Moderate Adverse.

3.6.6 Effects at Operation

Operational effects will result in:

- Potential effects of the development on landscape resources and landscape character, including the perceptual qualities of the landscape, and upon designated landscapes where the primary focus of designations or sensitive landscapes is altered;
- Potential and residual effects of the development on views and visual amenity of the area including likelihood of the development to alter the composition of views within the study area; and
- Potential cumulative effects of the development in combination with other planned and Proposed Developments of similar type and scale upon the landscape and visual resource of the study area.

3.6.7 Landscape Effects

The following potential direct and indirect landscape effects arising from the optimisation of Graffy Wind Farm have been identified, along with their duration and quality. Direct or indirect effects on the fabric of the landscape and its receptors are closely related to the nature and extent of visibility.

The Proposed Development is located within an mountainous upland area, which is intercepted by managed farmland and sections of commercial forestry. The Proposed Development site is located in Landscape Character Area 38: Bluestack, which according to the Landscape Character Assessment of County Donegal, is alluded to being of high landscape value and sensitivity, with a number of walking trails offering extensive and panoramic views over the surrounding Donegal Landscape. Key features surrounding the Proposed Development include undulating barren hills and mountains with strips of commercial forestry breaking the overall natural landscape to the north and south of the Proposed Development.

There will be no significant alteration in landscape character occurring as a result of the optimisation of Graffy Wind Farm, which includes the introduction of wind turbines, substation and a meteorological mast at the site location. Direct and long-term change will occur locally where the Proposed Development will be physically located. The landscape character at the site location will be similar when compared to the landscape effects caused by the formerly permitted development. Considering the omission of the formerly permitted Turbines 30 & 35, the extend of the proposed wind farm will be more concise, which will help to reduce landscape effects slightly as turbines will relate to each other more cohesively. The Proposed Development will continue to emphasise the addition of wind energy in this remote upland landscape; however, it will not impact on the value or quality of the surrounding landscape as a result of the proposed layout and the increased scale of turbines. The setting and siting of the proposed turbines have followed the DoEHLG 'Wind Energy Development Guidelines' to support the integration of the Proposed Development into its environs as much as possible. At the site location, the magnitude of landscape change is considered Low and the resulting significance is Slight Neutral when compared to the formerly permitted wind farm development. The Proposed Development will be seen as a similar element within the landscape as the formerly permitted development and is therefore not in contrast with the existing overall landscape character of the baseline study area. However, the Proposed Development will result in an intensification of wind energy infrastructure already formerly permitted due to the increase in height.

Indirect change will occur outside of the Proposed Development site boundary, where the greater extent of visibility of the Proposed Development compared to the formerly permitted scenario influences the perception of the character of the landscape. The indirect change in landscape character will be greatest where the formerly permitted turbines of Graffy Wind Farm are removed (refer to formerly permitted Turbines 30 & 35) and at locations where the wind farm would not have been seen before, particularly north of the study area at Carrickfin. The magnitude of change is considered Low to Medium as the Proposed Development, as well as the formerly permitted development, introduces wind energy infrastructure elements to the area at elevation. The significance of landscape effects on the landscape character in areas where the proposed optimised wind farm will now become visible is therefore considered to range from Slight Neutral to Moderate Adverse.

Changes to the landscape character in the remaining study area, are considered Low to Negligible. The significance is considered to range between Slight Adverse to Not Significant Neutral. While a change in landscape character may be noticeable in the distance due to the increase in height and scale of the optimized turbines, particularly from elevated locations, the Proposed Development will be similar to the baseline conditions of the formerly permitted development. The alteration to the landscape character in views from the south is mainly screened by intervening vegetation and topography at this distance. The Proposed Development will therefore not result in a change or modification of the wider landscape character. The landscape change at middle or long distances will range from Low to Negligible, with exception of elevated areas with views of the site. The significance is considered Slight to Not-Significant Neutral as the development site will be of similar nature to that of the formerly permitted scenario.

Table 12 Summary of Landscape Effects

Receptor	Susceptibility	Sensitivity	Magnitude of landscape change	Significance of landscape change
Landscape Character Area 'Bluestack' (Where there is visibility of Graffy Wind Farm is due to the formerly permitted development)	Medium	High	Low	Slight Neutral
Landscape Character Area 'Bluestack' (Where there is additional visibility of Graffy Wind Farm due to Proposed Development)	Medium	High	Low to Medium	Slight Neutral to Moderate Adverse

Receptor	Susceptibility	Sensitivity	Magnitude of landscape change	Significance of landscape change
Landscape Character Area 'Derryveagh' (Where there is visibility of Graffy Wind Farm due to the formerly permitted development)	High	Medium	Low	Slight Neutral
Landscape Character Area 'Derryveagh Mountains' (Where there is additional visibility of Graffy Wind Farm due to Proposed Development)	High	Medium	Low	Slight Adverse

3.6.8 Visual Effects

The Proposed Development is located along the southern slopes and foothills of Aghla Mountain. Croveenananta lies to the south with Boultypatrick to the east and Derkbeg Hill to the west. The site slopes from north to south crossing the valleys formed by the Stracashel, Stranagoppoge and Owenea Rivers. The land uses range from rough grazing, commercial conifer plantations and cut peat. Existing commercial forestry and other patches of vegetation can quickly provide partial or full screening to receptors when moving away from the site due to the undulating topography of the surrounding landscape. Visual effects resulting from the Proposed Development will be experienced from private and publicly accessible locations. The majority of significant views will be experienced within the core

5km study area where open or partial views of the development are possible, particularly in views from close proximity and at elevation, up to approximately 2km radius.

The highest change in visual effects will likely occur in short and middle-distance views, particularly from elevated areas, where there are no or few intervening hills / or vegetation. The magnitude of visual effects is considered to range from Low to Medium. The resulting significance is considered to range from Slight to Moderate Adverse when compared to the formerly permitted development. An increase is visual effects is mainly due to the alteration in turbine height.

In addition, sections of the Proposed Development will become visible in areas which previously had no visibility of the formerly permitted development. Additional visibility occurs in sections of the south-western and western study area, refer to Map 3 as included in Appendix B, which indicates areas of increased theoretical visibility up to blade tip height. The magnitude of additional visual effects in these area is considered Low to Negligible and their significance Slight Adverse to Not Significant Neutral. This is due to the long distance (between approximately 8-20km) and the relatively small extent of areas with additional views, which are generally attached to areas with existing views of the formerly permitted wind farm already. Areas to the southwest and west benefit also from a higher percentage of tree cover and other intervening vegetation, which will reduce the effects of additional visibility considerably.

Larger areas of additional visibility are generally located to the north and east of the Proposed Development site, refer to Map 3 as included in Appendix B. Areas with increased theoretical visibility are located at a distance between 3-20km from the Proposed Development site. The majority of additional visibility occurs between 4-15km to north of the site in areas located on higher ground and slopes facing south. A large portion of areas experiencing additional visibility are upland areas with low vegetation or areas not generally publicly accessible. In these areas, sections of the upper parts of turbines or blade sections will become a new element in available panoramic and often long distance views. The magnitude of visual effects is considered to range from Negligible to Medium. The resulting significance ranges from Not Significant to Moderate Adverse depending on the extent of visible sections of the wind farm in available views.

There will be no increase in visibility from locations around Lough Beagh and the majority of publicly accessible locations of Glenveagh National Park due to the introduction of the

Proposed Development. An increase in theoretical visibility has been identified along the upper most areas of the Derryveagh Mountains (Dooish) west of Lough Beagh and summits east of Lough Beagh. As for the formerly permitted development, visibility of the Proposed Development at a distance of approximately 26km and more will be highly weather dependent. The wind farm will be one point of focus amongst others in wide panoramic views.

Views from the N56 and the regional road network including the R250, R253, R254, R259, R261 & R262, located within the study area are mostly partially screened by intervening vegetation and topography. When compared to the formerly permitted development, sections of the R250, 253 and 254 will experience the majority of additional visibility of upper parts of the Proposed Development. The receptor groups along these roads consist mainly of local residents with a higher sensitivity to change and road users, which focus on traffic and not primarily on the view.

Long distance views from the wider study area (beyond 15km) and beyond will likely be possible from elevated locations or locations at lower ground without intervening screening vegetation. However, considering the distance to the Proposed Development, the optimisation will become less noticeable as the Proposed Development will form only a small part in overall wide and panoramic views. The Proposed Development will therefore integrate into the prevailing existing baseline character of available view, particularly when compared to the formerly permitted development. The magnitude of visual effects is considered Low to Negligible. The significance will range from Slight to Not Significant Neutral.

A detailed description and analysis of visual effects illustrated in 7 photomontages, produced from representative viewpoints located within the study area of 20km is included below.

3.6.9 Viewpoint and Photomontage Descriptions

Photomontages 1-7 illustrate a range of existing views from representative viewpoints located within the study area of 20km together with superimposed computer images depicting the Proposed Development (Showing a blade diameter of 132 metres and a hub height of 84 metres, resulting in a blade-tip height of 150 metres. This will cover both turbine types), and in comparison the formerly permitted development. The LVIA Photomontage Booklet is included in Appendix C.

Table 13 Viewpoint and Photomontage Descriptions 1-7

Viewpoint 1 – R252 Bellanamore

Viewpoint Details	View to the South West from R252 at Bellanamore Approximately 6.4 Kilometers North East of the nearest turbine Grid Reference: 596472.64, 902165.12 No. of turbines visible: 7/8 The existing panoramic view shows an open and expansive landscape. The topography is hilly and becoming mountainous in the background. The foreground is a river valley shaped by the River Finn with grassland and some shrubs and clusters of small trees located along the river. Taller vegetation becomes more widespread in the right of the view around dwellings and farmsteds. Boggy ground with heather cover are prominent in the middle ground followed by commercial forestry plantations. The upland in the background is typical mountain moorland but with sections of large areas of commercial coniferous forestry. Dwellings are generally sparse and scattered.
LCA & Sensitivity	Finn Valley LCA – Wind Turbines are a common feature within this Landscape Character Area, with this type of development deemed a 'Force For Change' within the County Development Plan. Receptors are likely to be residents of nearby dwellings and local vehicular traffic, who are considered to have a High susceptibility to change as views of the proposed wind farm are likely to be open from this location. The sensitivity of this view is considered Medium.
Qualitative Assessment	
'Do Nothing Scenario'	A number of turbines including upper tower sections, hubs and blades of the formerly permitted development would be visible from this

Viewpoint 1 – R252 Bellanamore

	viewpoint in the center of the image. The remaining wind farm would remain concealed by intervening topography and vegetation.
Photomontage Description	The photomontage and wireframe of the optimized proposal show the turbines move further upward above the ridgeline with tower sections, hubs and blades now visible in seven out of the eight turbines in this view. Where they are visible, the turbines are seen within a 'saddle' in the landscape, with higher ground flanking the view on both sides. The Proposed Development will become more prominent along the horizon as a result of the optimisation. However, due to the distance and screening available within the immidate surrounding landscape, the change will be Low and remain similar in nature to the formerly permitted development. The magnitude of visual effects is therefore considered Slight.
Significance of Visual Effects	Low Adverse. An effect which causes noticible change in the landscape and/or visual environment but without effecting its sensitivities.

Viewpoint 2 – R253

Viewpoint Details	View to the West from the R253 Approximately 3 Kilometers East of the nearest turbine Grid Reference: 594527.17, 897250.63 No. of turbines visible: 8/8 The existing panoramic view shows an open and expansive landscape from a remote section of the R253. The view is along an upland mountain valley with higher ground to either side and with Aghla Mountain in the background. The landscape is composed of moorland in the foreground, with some rocky outcrops seen in the near distance. The southern valley slopes are covered to a large extent with commerical coniferous forestry. An existing 110 kV overhead transmission lines runs along the valley in the middle distance. Isolated individual dwellings are also located in the middle distance.
LCA & Sensitivity	Bluestack LCA – Medium sensitivity around this viewpoint in the direction of the site (whilst this is located at the edge of the AEHSA which covers the Bluestack Mountains, the focus of the view is in the opposite direction) The sensitivity of this view is considered Medium.
Qualitative Assessment	
'Do Nothing Scenario'	The majority of the formerly permitted turbines would be fully visible in a distinct array across the southern valley slopes. The spacing and careful placing of this array ensures that the turbines, while a prominent feature, would not become a dominant feature within this view. Twelve of the formerly permitted thirteen turbines visible would be seen against the land, projecting their visibility more clearly than those with the backdrop of the sky.

Viewpoint 2 – R253

Photomontage Description	The proposed optimisation of Graffy Wind Farm will empasise the presence of the turbines in this and similar views along the R253 due to the combination of the increased scale and the fact the distance to the nearest turbine will reduce. While the Proposed Development will not dominante the view, the alterations to the formerly permitted development will be clearly recognisable and result in a more prominent presentation of the wind farm in this view. Considering the degree of visibility and nature of the proposed changes to the formerly permitted scheme, the magnitude of visual effects is considered Low-Medium.
Significance of Visual Effects	Slight-Moderate Adverse. An effect which causes noticible changes in the landscape and/or visual environment and alters sections of the landscape in a manner that is consitent with existing and emerging baseline trends.

Viewpoint 3 – R253

Viewpoint Details	View to the North West from R253 Approximately 2.1 Kilometers South East of the nearest turbine Grid Reference: 592950.80, 896639.42 No. of turbines visible: 8/8 Similar to Viewpoint 2, the existing panoramic view shows an open and expansive landscape from a remote section of the R253. The view is along an upland mountain valley with Aghla Mountain in the background. The landscape is composed of moorland in the foreground, with some rocky outcrops. Sections of the southern valley slopes in the distance are covered with commerical coniferous forestry. An existing low voltage overhead transmission lines runs along the

Viewpoint 3 – R253

	foreground in this view. An isolated individual dwelling is locted in the far distance.
LCA & Sensitivity	Bluestack LCA – Medium sensitivity around this viewpoint in the direction of the site (whilst this is located at the edge of the AEHSA which covers the Bluestack Mountains, the focus is not in this direction) The sensitivity of this view is considered Medium.
Qualitative Assessment	
'Do Nothing Scenario'	The formerly permitted turbines would have formed a distinct array across the view. While prominent, the spacing and careful placing of the formerly permitted array ensures that the turbines would not become a dominant feature within this view. Five of the eight turbines visible would be seen against the land, projecting their visibility clearly than those with the backdrop of the sky.
Photomontage Description	The proposed optimisation of Graffy Wind Farm will empasise the presence of the turbines in this and similar views along the R253 due to the combination of the increased scale and further spread of the wind farm along the upland slopes. While the Proposed Development will continue not to dominante the view, the alterations to the formerly permitted development will be clearly recognisable and result in a more prominent presentation of the wind farm. Additonal sections of blades will break the skyline in this view when compared to the formerly permitted development. However, the optimised Proposed Development will remain a balanced and legible composition. Considering the degree of visibility and nature of the proposed changes to the formerly permitted scheme, the magnitude of visual effects is considered Low-Medium.
Significance of Visual Effects	Slight-Moderate Adverse. An effect which causes noticible changes in the landscape and/or visual environment and alters sections of the

Viewpoint 3 – R253

	landscape in a manner that is consitent with existing and emerging baseline trends.

Viewpoint 4 – View from the Southern Development Site boundary

Viewpoint Details	View to the North East from a local road in the townland of Graffy Approximately 0.7 Kilometers South West of the nearest turbine Grid Reference: 589017.68, 895748.05 No. of turbines visible: 5/8 The existing view shows an undulating, hilly upland landscape which lies immediatley to the south of the site. The foreground is shaped by a small valley formed by the Stracashel River. Landcover includes upland grassland, open heath and clusters of coniferous vegetation, small decideous trees and shrubs in the fore and middle ground. Rocky outcrops and commerical coniferous plantations can be seen on higher ground in the background. There are no dwellings in the view.
LCA & Sensitivity	Bluestack LCA – Medium sensitivity around this viewpoint in the direction of the site (whilst this is located at the edge of the AEHSA which covers the Bluestack Mountains, the focus of the view is not in this direction) The sensitivity of this view is considered Medium.
Qualitative Assessment	
'Do Nothing Scenario'	Seven of the formerly permitted turbines and the met mast would be visible at different levels along the hills in the middle distance and extending in to the background (some visible elements include the blade tip only). Visible turbnines would form prominent features in this view and would mainly be seen against the sky.

Viewpoint 4 – View from the Southern Development Site boundary

Photomontage Description	The proposed optimisation of Graffy Wind Farm will reduce the number of turbines visible from 7 to 5. The met mast will remain visible. The reduction of turbine visibility is beneficial. The increase in turbine height will be clearly recognisable but given the more concise layout, the Proposed Development will not be substantially different to the formerly permitted scenario. The wind farm will remain a prominent feature in this view with all visible turbines and turbine sections seen against the sky. The magnitude of visual change is considered Medium.
Significance of Visual Effects	Moderate Neutral. An effect that alters the landscape in a manner that is consitant with existing and emerging baseline trends.

Viewpoint 5 – R250 North East of Glenties

Viewpoint Details	View to the East from the R250 North East of Glenties Approximately 6.2 Kilometers West of the nearest turbine Grid Reference: 583334.26, 896267.56 No. of turbines visible: 2/8 The existing view east shows a valley landscape with an flat foreground and undulating middle ground which rises up to a moutainous background. Moorland and clusters of shrubs, small trees and conifers shape the fore and middle ground, which is intersected by small fields adjacent to a dwelling. Commercial coniferous forestry shape sections of the middle ground. A number of low voltage overhead transmission lines are located in the fore- and middle ground. The upland regions in the background show outcrops of rocks and are mainly covered with heather and grasses.

Viewpoint 5 – R250 North East of Glenties

LCA & Sensitivity	Bluestack LCA – High sensitivity around this viewpoint as the view is orientated towards Aghla Mountain and the Bluestack Mountains. The latter is designated as a AEHSA. The sensitivity of this view is therfore considered High.
Qualitative Assessment	
'Do Nothing Scenario'	Five turbines and the met mast of the formerly permitted wind farm would be visible in this view. The turbine layout would be faily spread out across the lower slopes in the distance and would appear framented in the overall view.
Photomontage Description	The Proposed Development will reduce turbine visbility from 5 to 2 due to fewer numbers of turbines and a more concise layout. The visibility of the met mast will remain. One turbine will be clearly visible in this this view. The second turbine will become visible by its blade tip only. While the Proposed Development increases in height, the reduction of visibility from this and similar locations will be beneficial. The Proposed Development will be less prominent when compared to the formerly permitted development. The magnitude of visual effects is considered Medium.
Significance of Visual Effects	Moderate Beneficial. An effect that alters the landscape in a manner that is consistent with existing and emerging baseline trends.

Viewpoint 6 – Owenea Bridge / Wild Atlantic Way

Viewpoint Details	View from Owenea Bridge on the R261, North of Ardara Approximately 16.4 Kilometers West of the nearest turbine Grid Reference: 573660.88, 892003.19 No. of turbines visible: 5/8 The existing transient view shows a relatively open, expansive landscape with long distance views of Aghla Mountain from Owenea Bridge. Views east towards the formerly permitted wind farm along the R261 are often screened by either road side vegetation or other intevening vegetation further afield. The viewpoint is located on Owenea Bridge and includes the Owenea River in the foreground and overall gently undulating topography in the fore and middleground. Two dwellings can be seen in the left side of this view. An existing low voltage overhead transmission line is also crossing in the foreground. The topography begins to rise in the middle-ground and becomes mountainous in the background. The landcover in the uplands is typical mountain moorland but is intersected by large areas of commercial coniderous forestry. Views along this section of the R261 are intermittent and transient with few opportunities of open long distance views.
LCA & Sensitivity	Ardara Bays & Coast LCA – High sensitivity around this viewpoint as the view is along a popular costal tourist trail. The sensitivity of this view is therfore considered High.
Qualitative Assessment	
'Do Nothing Scenario'	A total of 4 formerly permitted turbines would be visible. One turbine would be openly visible by its upper tower, hub and blades, while only the blades and hubs of two further turbines are visible. One turbine would be visible by its blade tip only. The remaining turbines would be screened by intervening topography.

Viewpoint 6 – Owenea Bridge / Wild Atlantic Way

Photomontage Description	The photomontage and wireframe images of the Proposed Development indicate that the turbines move upwards within the 'saddle' of the ridgeline in the background with higher ground flanking the view on both sides. A total of 5 turbines will become vislble. Three by their upper tower sections, hubs and blades, and two by the blades only. The Proposed Development will become more prominent in this view due to the increase in turbine height. However, due to the distance and screening available within the immediate surrouding landscape along the R261, the change in turbine height and visibility will, while recognisable, not change the prominence of the wind farm significantly in this or similar transient views. The magnitude of visual effects is considered Low.
Significance of Visual Effects	Slight Neutral. An effect which causes noticible changes in the landscape and/or visual environment without affecting its sensitivities.

Viewpoint 7 R250 / Meenaboll Hill

Viewpoint Details	View South West from the R250 at Meenaboll Hill Approximatley 13.1 Kilometers North East of the nearest turbine Grid Reference: 600244.39, 907886.44 No. of turbines visible: 8/8 This open and panoramic view is across a gently undulating and remote landscape in the fore- and middleground and towards Aghla Mountain and the Blue Stack mountain range in the background. There is a variety of land cover types in this view, ranging from moorland/bog including tracts of coniferous forestry in the foreground and middleground, some sections of forestry is beginning to conceal the long distance views from this viewpoint location. A 110 kV

Viewpoint 7 R250 / Meenaboll Hill

	overhead transmission line is located in the middle distance and mostly screened by intervening forestry.
LCA & Sensitivity	Cark Mountain Uplands LCA – High sensitivity around this viewpoint as the view is an elevated view of the surrounding landscape . The sensitivity of this view is therfore considered High.
Qualitative Assessment	
'Do Nothing Scenario'	The upper parts of 7 formerly permitted turbines including tower, hub and blades would be visible from this location. One turbine would be visible by their blade only. The formerly permitted wind farm would form a clearly recognisable feature on the horizon in this long distance view.
Photomontage Description	The photomontage and wireframe images of the optimized Proposed Development indicate that the turbines move upward due to their revised layout and scale. Seven turbines will be clearly visible by their upper tower sections, hubs and blades. One turbine will be visible by its blades. The turbines will be visible along a slope and below the higher mountain ridge to the right. Higher mountain ridges are also located to the left in this view, which places the wind farm within a wide 'saddle' in the landscape. The Proposed Development will become slightly more prominent in this view when compared to the formerly permitted development. However, it will not alter further the panoramic nature of the view or provide an additional detraction in this view due to long distance between the proposal and the viewer. The magnitude of change in visual effects is therefore considered Low.
Significance of Visual Effects	Slight Neutral. An effect which causes noticible changes in the landscape and/or visual environment without affecting its sensitivities.

Table 14 Summary of Visual Effects in Photomontages 1-7

Viewpoint / photomontage	Distance to nearest turbine	Sensitivity	Magnitude of visual change	Significance of landscape change
1 - R252 Bellanamore	6.4 km	Medium	Slight	Low Adverse
2 - R253	3 km	Medium	Low to Medium	Slight to Moderate Adverse
3 - R253	2.1 km	Medium	Low to Medium	Slight to Moderate Adverse
4 – Southern Site Boundary	0.7 km	Medium	Medium	Moderate Neutral
5 – R250 North East of Glenties	6.2 km	High	Medium	Moderate Beneficial
6 – Owenea Bridge / Wild Atlantic Way	16.4 km	High	Low	Slight Neutral
7 – R250 / Meenaboll Hill	13.1 km	High	Low	Slight Neutral

3.6.10 Cumulative Landscape and Visual Effects

This section presents an assessment of the potential cumulative landscape and visual effects of the optimized Graffy Wind Farm with other relevant existing wind farms within the 20km study area.

Cumulative landscape and visual effects can arise in three reasonably distinct ways:

1. The effect of an extension of an existing development or the positioning of a new development such that it will give rise to an extended and/or intensified impression of the original wind farm in the landscape as seen from fixed locations.
2. Cumulative effects can arise through an increase in the perceptions of wind farm development as seen from fixed points from which more than one wind farm will now be seen in different parts of the landscape.
3. An increase in the incidence of sequential perceptions of different turbines can occur through the recurrence of images and impressions arising from developments which are located at various points in the landscape and which are encountered when moving through it.

Appendix B contains ZTV Maps 1-4 illustrating the theoretical visibility of the formerly permitted development and the Proposed Development. The majority of turbine visibility is extending to the north, northwest and southwest with isolated patches in the east. Visibility to the south and southeast is obstructed by the Blue Stack Mountain range and to the northwest by Aghla Mountain. A number of existing wind farms are located within the 20km study area. Based on the ZTV mapping the most relevant existing wind farm for assessing cumulative effects is Loughderryduff Wind Farm, which is located approximately 15km west of the formerly permitted site and the Proposed Development. Details on Loughderryduff Wind Farm are enclosed in Table 16 below.

Table 15 Cumulative developments considered within this assessment

Scheme	Approximate distance from development site centre	Status	Description
Loughderryduff Turbines	15km	Operational	Planning permission for this site was granted by Donegal County Council in 2004. The development consists of 9 number Vestas V52 wind turbine generators and crane hardstanding for each turbine, electrical substation, underground electrical cabling, access tracks and ancillary services.

Map 4 (refer to Appendix B) indicates the location of Loughderryduff Wind Farm and the joint theoretical visibility of the formerly permitted and the Proposed Development.

Areas with theoretical cumulative visibility of both schemes are limited to the western extent of the study area, elevated areas north relating to the Glendowan Mountains and Slieve Snaght as well as along the northern and western slopes of the Blue Stack Mountains in the south.

The majority of cumulative effects between both developments occurs in areas away from the public road network and in areas not generally accessible to the public. Joint visibility from the public road network will be from small pockets. The majority of views will be successive in nature, i.e. the viewer can either see one or the other development without turning the head due to the considerable distance between both developments. Both developments will be perceived as fully separate schemes. Combined visibility will be possible from locations at high ground to north within the Glendowan Mountains and Slieve Snaght and areas along the western side of the Blue Stack Mountains. However, even at those locations, the viewer will likely need to move the head slightly to see sections of both developments together. While the visibility of the Proposed Development will increase slightly in the above mentioned area, areas of potential cumulative visibility do not increase equally. Considering the formerly permitted development, the Proposed Development will not result in a significant increase in cumulative landscape and visual effects, due to the distance between both developments and the location, scale and nature of Proposed Development. The magnitude of cumulative landscape effects is considered Very Low. The significance of landscape effects will be Not Significant Neutral. The magnitude of visual cumulative effects following the optimisation of the Proposed Development is considered Low and the significance will be Slight Neutral.

3.7 Mitigation

Wind turbines are by their nature highly visible elements and cannot be easily screened. Their function dictates that they are located on exposed sites. However, in some cases, the topography of the site can be used in order to screen the development from sensitive viewpoints.

The following mitigation measures were taken into account during the planning of the optimised Proposed Development during the layout and design of the turbines, met mast, substation structures and underground cabling.

3.7.1 Siting, Design and Layout

The aim of the Proposed Development is to provide a more concise layout, when compared to the formerly permitted layout, with lesser but higher turbines to avail of the latest technologies available. The proposed layout has been based on the following key principles:

Wind Farm:

- To produce a clear and simple layout that was visually unified and that continues to relate to the surrounding landform;
- To minimise visual confusion;
- To provide visual balance and harmony. Harmony and balance create clarity;
- To provide visual unity; and
- Minimise adverse cumulative effects with proposed surrounding wind farms.

Ancillary structures (substations, underground cables, access roads):

- Restricting the siting of structures close to residential dwellings;
- Underground cables to utilise existing roads and access tracks, where possible;
- Minimise the length and land take of the proposed access roads during construction and operation; and
- Access roads to be as level with the existing ground, where possible.

3.7.2 Colour

Wind Farm:

A number of colour options have been considered to reduce the visual impact of the proposed turbines. The turbines will be seen against the land and the sky depending on the location of the viewpoint. It is proposed to use a Goosewing Grey or matt white. These colours are neutral and the appearance of these colours means that whatever the weather conditions or nature of the surrounding landscape characteristics, the turbines will never aesthetically clash in colour. Taking into consideration the prevailing weather conditions within the centre of the study area, a darker colour other than Goosewing Grey or matt white will make the turbines appear more prominent and industrial in character. They will also be more visible against the clear sky.

Substation:

- Appliance of a dark ochre colour matching the surrounding bog grassland for all substation building structures to help the integration of the buildings into the surrounding landscape in close and distant views;
- Use of material for building facades/cladding, fencing and gates which is local or appropriate to the area in scale, colour and design.

3 8 Summary

3.8.1 Construction Effects

Landscape and visual effects during the construction stage will be experienced at the location of the proposed wind turbines and met mast as well as their surroundings due to earth works, foundation works, construction of access roads and construction of wind turbine and met mast structures. Construction works will also include the installation of underground cables from the turbine / met mast locations to the nearest local road as well as along existing local roads (mainly L7593) and access tracks to the existing EirGr idTievebrack Substation located approximately 3km northeast of Glenties. Construction works will also be experienced at the proposed substation location and along the local road network where construction traffic will travel. The effects arising during construction will result from machinery, personnel, excavations, traffic and material movements.

Landscape and visual effects will be highest within approximately 500m radius from the Proposed Development site boundary where open or partial views of the construction works become possible. The visibility of construction works within the wider study area (beyond approximately 500m from the Proposed Development site boundary) will depend on the location of the observer and the extent of intervening topography and vegetation. It will include sections of wind turbines and the met mast, sections of the proposed substation and machinery (for example cranes, cable laying machines or other moving construction traffic) and material storage areas.

The majority of receptors will be local residents and visitors driving through the study area within approximately 500m from the Proposed Development site boundary. Residential receptors are considered to have a highest sensitivity to visual or landscape changes as they will experience changes in views on a daily basis. However, considering the undulating landscape with steep slopes, open views of construction works will be limited to local areas.

Middle distance views and long distance views of the construction works will mainly be possible during the assembly of the wind turbines, the met mast and substation components. Visibility will increase with the increasing height of the proposed structures and relevant assembly machinery required.

3.8.2 Landscape Effects

There will be no significant alteration in landscape character occurring as a result of the optimisation of Graffy Wind Farm, which includes the introduction of wind turbines, substation and a meteorological mast at the site location. Direct and long-term change will occur locally where the Proposed Development will be physically located. The landscape character at the site location will be similar when compared to the landscape effects caused by the formerly permitted development. Considering the omission of the formerly permitted Turbines 30 & 35, the extend of the proposed wind farm will be more concise, which will help to reduce landscape effects slightly. The Proposed Development will continue to emphasise the addition of wind energy in this remote upland landscape; however it will not impact on the value or quality of the surrounding landscape as a result of the proposed layout and the increased scale of turbines.

In the context of the wider area, the Proposed Development will be seen as a similar element within the landscape as the formerly permitted development and is therefore not in contrast with the existing overall landscape character of the baseline study area. However, the Proposed Development will result in an intensification of wind energy infrastructure already formerly permitted due to the increase in height.

Indirect change will occur outside of the Proposed Development site boundary, where the greater extent of visibility of the Proposed Development compared to the formerly permitted scenario influences the perception of the character of the landscape. The indirect change in landscape character will be greatest where the previously formerly permitted turbines of Graffy Wind Farm are removed (refer to formerly permitted Turbines 30 & 35) and at locations where the wind farm would not have been seen before, particularly north of the study area at Carrickfin.

Changes to the landscape character in the remaining study area are not considered significant. While a change in landscape character may be noticeable in the distance due to the increase in height and scale of the optimized turbines, particularly from elevated locations, the Proposed Development will be similar to the baseline conditions of the formerly permitted development. The alteration to the landscape character in views from the south is mainly screened by intervening vegetation and topography at this distance. The Proposed Development will therefore not result in a change or modification of the wider landscape character.

3.8.3 Visual Effects

Visual effects resulting from the Proposed Development will be experienced from private and publicly accessible locations. The majority of significant views will be experienced within the core 5km study area where open or partial views of the development are possible, particularly in views from close proximity and at elevation, up to approximately 2km radius. The highest change in visual effects will likely occur in short and middle-distance views, particularly from elevated areas, where there are no or few intervening hills / or vegetation.

In addition, sections of the Proposed Development will become visible in areas which previously had no visibility of the formerly permitted development. Additional visibility occurs in sections of the south-western and western study area, refer to Map 3 as included in Appendix B, which indicates areas of increased theoretical visibility up to blade tip height. The increase in turbine visibility is not considered significant due to the long distance (between approximately 8-20km) and the relatively small extent of areas with additional views, which are generally attached to areas with existing views of the formerly permitted wind farm already. Areas to the southwest and west benefit also from a higher percentage of tree cover and other intervening vegetation, which will reduce the effects of additional visibility considerably.

Larger areas of additional visibility are generally located to the north and east of the Proposed Development site, refer to Map 3 as included in Appendix B. Areas with increased theoretical visibility are located at a distance between 3-20km from the Proposed Development site. The majority of additional visibility occurs between 4-15km to north of the site in areas located on higher ground and slopes facing south. A large portion of areas experiencing additional visibility are upland areas with low vegetation or areas not generally publicly accessible. In these areas, sections of the upper parts of turbines or blade sections will become a new element in available panoramic and often long distance views.

There will be no increase in visibility from locations around Lough Beagh and the majority of publicly accessible locations of Glenveagh National Park due to the introduction of the Proposed Development. An increase in theoretical visibility has been identified along the upper most areas of the Derryveagh Mountains (Dooish) west of Lough Beagh and summits east of Lough Beagh. As for the formerly permitted development, visibility of the Proposed Development at a distance of approximately 26km and more will be highly weather dependent. The wind farm will be one point of focus amongst others in wide panoramic views.

Views from the N56 and the regional road network including the R250, R253, R254, R259, R261 & R262, located within the study area are mostly partially screened by intervening vegetation and topography. When compared to the formerly permitted development, sections of the R250, 253 and 254 will experience the majority of additional visibility of upper parts of the Proposed Development. The receptor groups along these roads consist mainly of local residents with a higher sensitivity to change and road users, which focus on traffic and not primarily on the view.

Long distance views from the wider study area (beyond 15km) and beyond will likely be possible from elevated locations or locations at lower ground without intervening screening vegetation. However, considering the distance to the Proposed Development, the optimisation will become less noticeable as the Proposed Development will form only a small part in overall wide and panoramic views. The Proposed Development will therefore integrate into the prevailing existing baseline character of available view, particularly when compared to the formerly permitted development.

3.8.4 Cumulative Effects

Cumulative landscape and visual effects may result from additional changes to the baseline landscape or views as a result of the Proposed Development in conjunction with other developments of a similar type and scale.

ZTV Maps 3 and 4, as included in Appendix B, illustrate the theoretical visibility of the formerly permitted development and the Proposed Development as well as with other relevant existing wind farms. The majority of turbine visibility is extending to the north, northwest and southwest with isolated patches in the east. Visibility to the south and southeast is obstructed by the Blue Stack Mountain range and to the northwest by Aghla Mountain. A number of existing wind farms are located within the 20km study area. Based on the ZTV mapping the most relevant existing wind farm for assessing cumulative effects is Loughderryduff Wind Farm with 9 turbines, which are located approximately 15km west of the formerly permitted site and the Proposed Development.

Map 3, as included in Appendix B, contains ZTV mapping illustrating the theoretical visibility of the formerly permitted development and the Proposed Development. The majority of turbine visibility is extending to the north, northwest and southwest with isolated patches in the east. Visibility to the south and southeast is obstructed by the Blue Stack Mountain range and to the northwest by Aghla Mountain. Map 4, as included in Appendix B, indicates also the location of Loughderryduff Wind Farm and the joint theoretical visibility of the formerly permitted and the Proposed Development.

Areas with theoretical cumulative visibility of both schemes are limited to the western extent of the study area, elevated areas north relating to the Glendowan Mountains and Slieve Snaght as well as along the northern and western slopes of the Blue Stack Mountains in the south.

The majority of cumulative effects between both developments occurs in areas away from the public road network and in areas not generally accessible to the public. Joint visibility from the public road network will be from small pockets. The majority of views will be successive in nature, i.e. the viewer can either see one or the other development without turning the head due to the considerable distance between both developments. Both developments will be perceived as fully separate schemes. Combined visibility will be possible from locations at high ground to north within the Glendowan Mountains and Slieve Snaght and areas along the western side of the Blue Stack Mountains. However, even at those locations, the viewer will likely need to move the head slightly to see sections of both developments together. While the visibility of the Proposed Development will increase slightly in the above mentioned areas, areas of potential cumulative visibility will not increase equally. Considering the formerly permitted development, the Proposed Development will not result in a significant increase in cumulative landscape and visual effects, due to the distance between both developments and the location, scale and nature of Proposed Development.

Appendices A, B and C are included in Volume 2 of the EIAR.

Appendix A

Figure 1: Landscape Designations County Donegal

Figure 2: Designated Walking, Cycling and Driving Routes County Donegal

Figure 3: Designated Views and Prospects County Donegal

Appendix B

Map 1: Zone of Theoretical Visibility (ZTV) Map indicating areas with a theoretical view of the proposed Graffy turbines - Calculated to Hub Height (84m)

Map2: Zone of Theoretical Visibility (ZTV) Map indicating areas with a theoretical view of the proposed Graffy turbines – Calculated to Blade Tip Height (150m)

Map 3: Zone of Theoretical Visibility (ZTV) map indicating areas with increased theoretical visibility as a result of the proposed design change to the Graffy wind farm - Calculated to Tip Height

Map 4: Zone of Theoretical Visibility (ZTV) map indicating areas with a theoretical view of the proposed Graffy wind farm, in combination with other relevant existing wind farms & the formerly permitted Graffy Wind Farm within the study area

Appendix C

LVIA Photomontage Booklet (prepared by Innovision Ltd.)

4. Population and Human Beings

Table of Contents

List of Figures

List of Tables

List of Annexe (See Appendix 3 in VOLUME 3-APPENDICES)

4. Population and Human Health

4.1. Introduction

4.1.1. Scope and Purpose

Population and Human Health is a requisite assessment area under current national guidelines for Environmental Impact Assessment Reports (EIAR)[1]. This Chapter presents an assessment of the potential impacts to human beings, population and human health along with the socio-economic context resulting from the development of the proposed Graffy Wind Energy and Grid Connection Project. This proposed wind park already has planning permission consent for a 13-turbine wind farm.

It is now proposed as of September 2021 for 8 no. wind turbines and ancillary development with two wind turbine model options assessed. The two turbine models assesed are the Enercon or Nordex N 133 (Option 1) and the E 126 (Option 2) that have similar geomeric dimensions. The maximum base to blade tip height would be up to 149.6m for either wind turbine model. Ancillary developments include hard standing areas and access tracks, a temporary construction compound, a meteorological mast and a substation. The power output of the wind park project is capped at 35.88 MW as this is the limit on the grid connection.

The proposed development is in the townlands of Graffy, Meenamanragh, and Dalraghan More, Meenagrubby, Glenties, County Donegal; and an underground grid line to connect the proposed wind farm to the existing Tievebrack ESB station near Drumalough Hill, Glenties, County Donegal.

A more detailed description of the proposed development is included in Chapter 3.

This section describes the potential impacts of the proposed development on human beings, population and human health. The impacts of a wind energy development hold potential to impact on human beings, directly and indirectly, positively and negatively. The Environmental Impact Assessment process identifies significant impacts and proposes mitigation to ensure that people, as individuals or communities, should experience no reduction in the quality of life

[1] *'Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports'* (EPA, August 2017)

resulting from the direct or indirect impacts of the construction, operation or decommissioning of a development.

'Human Health Receptors' can be described as including future site users and construction workers. The main issues considered here include population, human health, employment and economic activity, land-use, residential amenity and residential visual amenity, community facilities and services, tourism, TV reception, property values, shadow flicker, air quality, noise and health & safety.

The purpose of this Chapter of the Environmental Impact Assessment Report is to:

- Describe the current socio-economic context and the groups likely to be affected by the proposed development.
- Identify the *potential likely impacts* of the proposed development upon humans and the socio-economic context. This will categorise headings including: socio-economic aspects of population, community and economic activity including tourism; physical land use; health related aspects including safety, noise/vibration, air quality, and shadow flicker; as well as property values and visual residential amenity impacts.
- Identify *mitigation measures* to avoid, remediate or reduce the likely impacts identified.
- Identify *residual impacts* of the development after implementation of the mitigation measures recommended
- Comment on cumulative effects with regard to other wind energy projects in the study area

Impacts are summarised in sub-section 4.8 and a Non-Technical Summary (NTS) is separately provided in Volume 3 of the EIAR.

Consideration of the effects on populations and on human health includes focus on health issues and environmental hazards arising from the other environmental factors, for example water contamination, air pollution, noise, accidents and disasters.

Aspects of this chapter relate to other chapters of the EIAR. There are stand-alone chapters on several components including noise, landscape and visual assessment, water and soils, air and climate and community consultation. Relative assessments are more detailed in these specific chapters and are so referred in the text.

No significant difficulties were experienced in compiling this assessment.

4. 1.2. Statement of Authority of the Authors

Canavan Associates Ltd. is a Chartered Town Planning, Environmental and Architectural Consultancy, comprising Town Planners, Environmental Managers, Architect and technical staff and specialised expert and associate personnel. The Practice has been stablished over three decades and is based in Prince's Street, in the central business district of Derry, Northern Ireland.

The company is involved in projects throughout the island of Ireland and has vast experience in planning and Environmental Impact Assessment, with specialist expertise in wind farm planning and development, planning applications, environmental studies and reports, feasibility studies, development plans and environmental management plans.

Staff are corporate members of the following professional institutes:

- Royal Town Planning Institute (RTPI)
- Irish Planning Institute (IPI)
- Institute of Environmental Management and Assessment (IEMA)
- Institute of Ecology and Environmental Management (IEEMA)
- Royal Institute of Architects of Ireland (RIAI)

The staff who contributed to this Chapter are:

- Seamus Canavan BA (Hons.) BA (Hons) MA MIPI MRTPI, Chrtd. Town Planner
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4.2. Assessment Methodology

4.2.1. Introduction

This assessment has been carried out as part of the EIAR for the proposed development. This section of the EIAR identifies the potential impacts of the proposed development on the local economy and employment in the area, and considers the business related opportunities that are likely to be available to local firms. The potential effects of the proposed Graffy Wind Energy and Grid Connection Project on residential amenity and recreational users of the area are also considered within this assessment.

The assessment relates to both turbine models under consideration for installation: i.e. options of the E126 and N133. These are assessed both independently in certain aspects, such as wireframe visuals and shadow flicker; and where appropriate in combination, with regard to maximum dimensions such as their maximum blade tip height.

Assessment of relevant socio-economic effects, and more detail on residential amenity is expanded upon in the following chapters:

- Landscape and Visual Impact Assessment – LVIA (Chapter 3);
- Noise (Chapter 5);
- Traffic and Transport (Chapter 11);
- Air, Climate and Climate change (Chapter 8);

A census data map and house ID map are also included.

The full shadow flicker assessments for the proposed development is contained as Annex 4-1 to this Chapter.

A detailed Residential Visual Amenity Assessment (RVAA) with methodology is included as Annex 4-2. Wireframes portraying the two different turbine models are attached and are also described under visual residential impacts sections. The 11 no. wireframes are in opposite page A3 sets and represent visualisation of the turbine models from various houses and also include house photographs (not visual representations).

Annex 4-1 Shadow Flicker Reports, Annex 4-2 RVAA section and the wireframes Figures 4-1 to 4-14 are included in the Human Beings section of Appendices in Volume 3 of the EIAR.

The Shadow Flicker Maps and Wireframes figures have further separate figures for both Option 1 (N133) and Option 2 (E126) turbine models as individually itemised in the list of contents.

The general figures are thus:

- Fig 4-1: House Layout Map
- Figs. 4-2-1 & 2: Shadow Flicker Maps for both turbine options
- Fig 4-3: Map showing location of Proposed Graffy Wind farm, Gaeltacht areas, electoral districts and areas and Settlements.
- Fig 4-4-1 & 2 : Wireframe Views from House H2 for both turbine options
- Fig 4-5-1 & 2: Wireframe View from House H5 for both turbine options
- Fig 4-6-1 & 2: Wireframe View from House H6 for both turbine options
- Fig 4-7-1 & 2: Wireframe Views from House H7 for both turbine options
- Fig 4-8-1 & 2: Wireframe Views from House H8 for both turbine options
- Fig 4-9-1 & 2: Wireframe Views from House H9 for both turbine options
- Fig 4-10-1 & 2: Wireframe Views from House 15, also representative of view from House H14 for both turbine options
- Fig 4-11-1 & 2: Wireframe Views from House H17 for both turbine options
- Fig 4-12-1 & 2: Wireframe Views from House 20, also representative of Views from Houses H19 & H21 for both turbine options
- Fig 4-13-1 & 2: Wireframe Views from House H23 for both turbine options
- Fig 4-14-1 & 2: Wireframe Views from House H25, also representative of Views from House H26 for both turbine options
- Fig 4-15: Proposed route for the delivery of turbine components to site from port of delivery at Killybegs.

4.2.2 Policy and Guidance

This population and human health impact assessment has been undertaken in accordance with Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, as amended by Directive 2014/52/EU and as transposed into Irish Law through Regulations in 2018 (S.I. No. 296 of 2018). The assessment was carried out in accordance with the following guidance and tailored accordingly based on professional judgement:

- EPA Guidelines on the Information to be Contained in Environmental Impact Statements (EPA, 2002) (and revised draft guidelines August 2017);
- EPA Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (EPA, 2003) (and revised draft advice notes September 2015); and
- Fáilte Ireland Guidelines, on the treatment of Tourism in an Environmental Impact Statement (provided by Fáilte Ireland as part of their submission to the Scoping request issued to them for this project).
- Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment Report. European Commission. 2017;
- Health Impact Assessment Guidance, Institute of Public Health Ireland. 2009;
- Donegal County Development Plan 2018 – 2024

The description of the quality, significance, extent (magnitude), probability and duration of effects outlined within this assessment are based on the definitions set out within Section 3.7 of the 'Guidelines on information to be contained in Environmental Impact Assessment Reports' (EPA, Draft 2017).

Wind Energy Development Guidelines

The current applicable Wind Energy Development Guidelines were published in 2006 by the Department of Environment, Heritage and Local Government (DoEHLG), and were expanded upon in an updated draft version in 2019[2]. New guidance has been published in draft form but is yet to be adopted. The current Guidelines offer advice to planning authorities on wind energy developments and contain information on environmental impact assessment, environmental implications, siting and design and planning conditions.

[2] Department of Housing, Planning and Local Government. (2019). 'Draft Revised Wind Energy Development Guidelines'. https://www.housing.gov.ie/sites/default/files/public-consultation/files/draft_revised_wind_energy_development_guidelines_december_2019.pdf

The Guidelines state that developers should be encouraged to consult with the local community, however this is not compulsory. The Guidelines also contain best practice information on pre-application community consultation.

Information on local environmental impacts such as shadow flicker and noise should be provided to be taken into consideration with a number of other factors. The Guidelines however do not specify any socio-economic factors to be taken into consideration apart from cases where international sites of nature conservation are under consideration. In this instance, permission will only be granted if it is in the overriding public interest, which can be of a social or economic nature.

4.2.3 Impact Assessment Criteria

There are no formal or published guidelines for the impact assessment of wind farms on population and human health. The impact assessment process has become the structure for this assessment and professional judgement has been informed by desk-based research.

The baseline population (social and economic) and health environments are described with reference to census data and any other available information.

Potential impacts to population and human health are then identified. These have included potential impacts to society, the economy, traffic and access, tourism, the noise environment, air and climate, health, safety and wellbeing. The significance of these impacts has then been assessed. Potential for impacts to residential amenity are also touched on.

4.2.4 Field Surveys

Site investigations were undertaken in areas in proximity of the proposed development lands to appraise the location, identify and map the location of sensitive receptors and to identify the potential for impacts on human receptors. This work was undertaken in 2020.

4.2.5 Desk top surveys - Sources

A socio-economic profile was compiled for this EIAR from maps and data obtained from the Central Statistics Office (CSO), the Donegal County Development Plan 2018-2024, the Census of Ireland, Fáilte Ireland, and other literature relevant to the area.

The study included an examination of the population and employment characteristics of the area. This information was sourced from the Census of Ireland 2011 and 2016, which are the most recent censuses, the Pobal agency, and from the CSO website, www.cso.ie.

In this chapter of the EIAR, data at District Electoral Division (DED) level has been used where possible.

4.2.6. Community Consultation

Community and local consultation is normally carried out as good practice to inform local residents of a development that will be undertaken in their area. Whilst it is not presently mandatory for the subject planning application, the developers of the proposed Graffy Wind Energy and Grid Connection Project chose to inform local residents, communities and elected representatives about the proposal and to provide them with a contact point for information. This is also a useful exercise to determine the nature of local community concerns in relation to the proposed development.

An information brochure was prepared to provide information about the proposed development and the ongoing Environmental Impact Assessment. This was delivered online via the public information website http://www.graffywindpark.com/ rather than in person due to the current restrictions and safeguards associated with the coronavirus pandemic. A public meeting in Edeninfagh Parish Hall, Glenties, was scheduled for early April, but the escalation of the coronavirus pandemic prompted new government restrictions which prevented large community gatherings. In lieu of a public consultation, members of the public were invited to submit their views and any queries on the proposed development in writing to Harley Planning Consultants, via the public information website (www.graffywindpark.com), or by email to comments@graffywindpark.com.

There were a total of 3,576 hits on the website up until the end of June 2020. Table 4-1 gives a breakdown of the submissions received.

Table 4-1: Response submissions from public consultation

Type of subm issiơn	Number of individual submissions
Telephone calls of support	2
Letters of support	4
Emails of support	3
Emails of objection	2
Objections to Eirgrid substation	3
Seeking inclusion for compensation	2
Seeking financial support to rebuild burnt out house	1
Product offers	23

The number of hits to the website indicate that a large number of people have been able to access details of the proposed development and would have been offered the opportunity to make a submission if they wished. Only 40 no. individual submissions were received. The majority of these (23 no.) were from companies and suppliers offering products and services. Of the 17 no. project specific submissions, 9 no. were submissions in support of the development.

Of all those 3,576 persons that viewed information on the development, only 8 no. submissions raised concerns about the project. This indicates that most of those that viewed the website were generally content with the development.

Concerns raised by members of the public have been taken on board by the development scheme. A community fund will be established to benefit those in proximity to the proposed development. Details of this scheme will be drawn up in agreement with the Council and relevant stakeholders.

4.3. Characteristics of the Proposed Development

The proposed Graffy Wind Farm will comprise 8 no. wind turbines and ancillary developments. This EIAR chapter provides for an assessment of the two proposed turbine models: the Nordex N 133 (Option 1) or the Enercon E 126 (Option 2).

These two turbine types are similar in geometric mesurements for blade length, hub height, blade tip height and rotor diameter.

The power output in MW is identical for each of these two turbine options as power output is fixed by the grid connection offer at 35.88MW or 4.48MW power turbine maximum output.

Only one of the two turbine models will be erected. Wind turbine availability is very fluid, due to technical advances and companies frequently cease manufacture of their models. The applicants wish to ensure that at least one of their identified turbines will be available for erection. The turbine models assessed specific measurements are set out below in Table 4.2.

Table 4-2: Turbine models assessed in EIAR.

Turbine Model	Hub Height	Rotor Diameter	Blade Tip Height	Blade Length
Nordex 133 (WT model Option 1)	83 metres	133.2 metres	149.6 metres	64.4 metres
Enercon 126 (WT model Option 2)	85.94 metres	127 metres	149.44 metres	61.09 metres

Considering both turbine model options, the a maximum dimensions will be hub height of 85.94m, blade diameter of 133.2m, blade tip height 149.6m and blade length of 64.4m.

The proposed development will also comprise of access tracks to each turbine, a substation, cables connecting the turbines to the proposed substation, a meteorological mast, peat recovery areas and a temporary construction compound.

In addition, this EIAR assessment includes the development of a grid connection from the proposed substation serving the wind park to the Tievebrack ESB station near Glenties, approximately 7km west of the wind park site.

The EIAR also assessed the strengthening, widening and extension of culverts along existing roads and the development of a new section of road to facilitate the delivery of turbines and associated parts

The amended wind farm is proposed in lieu of the permitted wind energy project on this site that comprises 13 turbines, substation and associated site roads [An Bord Pleanála Reference Number: PL 05B.237656 and Donegal Co. Council PA Reg. Ref. 09/30520].

Ancillary development

This will include an underground grid connection, substation as well as site infrastructure of, for example, tracks and drainage and a temporary construction compound. A temporary anemometer mast has already been erected on the site, which will be replaced by a permanent meteorological mast.

Underground grid connection

A connection between the proposed Graffy wind farm and the national electricity grid will be necessary to export electricity from the proposed wind farm. The current planning application for the proposed development seeks permission for a proposed 38kV grid connection substation at Meenagrubby which would connect, via a 7.5km stretch through the townlands of Drumnalough, Drumnacoose, Meenamalragh, Stracashel, Banganboy, Graffy, Meenamanragh, Meenagrubby & Dalraghan More, Glenties, to the existing Tievebrack Eirgrid Station in Drumnalough, Glenties, Co. Donegal. The grid connection would primarily run under the public road from the proposed substation to Meenamalragh townland, before passing under a private road to the Eirgrid Tievebrack Station. This route is indicated in an Overall Site Layout drawing no. 19-014-001 Rev 1-1 dated May 2020 included in the EIAR.

The proposal of underground grid connection cabling, although more costly than overhead cabling, will remove any visual or landscape impact associated with this grid connection aspect. A more detailed description of the grid connection aspect, including the construction methodology for the wind farm and proposed grid connection, can be found in the separate EIAR Chapter 2, providing a Development Description.

The land-use along the undergrounded grid connection comprises mainly public roads, and surrounding land use is mainly agriculture with some areas of peat harvesting and forestry. Chapter 10 addresses the potential for the proposed development to result in impacts to Biodiversity and would have additional information.

The active construction area for the grid connection will be small, ranging from 150 to 300 metres in length at any one time. Construction works will be transient in nature as the grid line construction works progress along the route. In the event that separate construction crews are used during the construction of the underground grid-line, they will generally be separated by one to two kilometres.

Abnormal Load delivery route

The proposed route for the delivery of turbine components and materials for civil works during the construction phase has been assessed. It is proposed that the turbine components would arrive into the port of Killybegs in Co. Donegal before travelling along the N56, N15 and R252 roads, as indicated in Figure 4-15 below.

Figure 4-15: Proposed route for the delivery of turbine components to site from port of delivery at Killybegs.

Potential haulage routes from the port of delivery to site have been assessed (Refer to EIAR Chapter 11– traffic and transport) and the proposed route appears to be the optimum arrangement in terms of existing public road conditions, extent and provision and least inconvenience/interference with the local community.

Site Reinstatement

Following the completion of construction works, site reinstatement works will be undertaken to include:

- The removal of all waste and recyclable materials from the site of the wind farm and the grid line works area, their collection and transfer by licensed contractor to an authorised facility,
- The clearance and spreading of spoil to facilitate landscaping and roadside berm formation.
- The replacement of saved turves of surface vegetation, to facilitate ground stabilisation, the reduction of bare earth areas, and the establishment of ground cover.

- The reseeding of bare earth with local species, as necessary and as outlined in the Ecological Impact Assessment Report.
- Infilling of grid line trench and replacement of excavated vegetated turves on the surface.

Wind Farm Operation

Once constructed and operational, the wind farm will continue to generate electricity for a period of up to 25+ years. At this time a decision will be made whether to decommission or repower the wind farm development.

Wind Farm Decommissioning

If wind farm decommissioning is to be undertaken, a plan will be drawn up to define the proposed decommissioning works. This will be drawn up in agreement with the Local authority and relevant stakeholders at that time.

4.4. The Receiving Environment

4.4.1 Study Area

There is no national guidance available on an appropriate study area to focus the assessment of population and human health. The study area has been defined with reference to the potential for impact from the proposed development using professional judgement and based on availability of relevant information.

This Chapter is based on a desk survey and site visits to a study area located within County Donegal and is defined in terms of District Electoral Districts (DEDs).

All DEDs within an area of 10km radius around the proposed development site will together be referred hereafter as the Study Area for this chapter. These DEDs are Ardara, Altnapaste, Binbane, Cloghan, Doocharry, Eanymore, Fintown, Glenleheen, Glenties, Graffy, Haugh, Lettermacward and Lough Eask. A map of the study area, and the electoral and government boundaries contained within it, can be seen in Figure 4-3.

Most of the study area is within the Donegal Gaeltacht. In Co. Donegal some 37% of the population are Irish speakers[3]. The Gaeltacht has its own development agency: Údarás na Gaeltachta.

4.4.2 Proposed Development Site

This section presents information on the existing population and human health conditions in the area where the Wind Farm and grid connection is situated. It also provides details on known recreation and tourism activities in the area and information on the current land use of the site.

4.4.2.1 Development Area

The Proposed Development is located in a number of townlands as follows: Graffy, Meenagrubby, Meenaleenaghan, Meenachuit, Dalraghan More, Meenamanragh, Meenavale, Greenans, Stralinchy and Mully, all located in Co. Donegal. The main wind energy site is located 7km east of the town of Glenties and 3.8km south-west of the village of Fintown.

For the purposes of this EIAR, where the 'Proposed Development site' or 'the site' is referred to, this relates to the development area for the Proposed Development, as delineated in red on the EIAR figures (maps). The proposed actual development footprint will occupy only a small proportion of the overall red-lined planning outline area. The location co-ordinates of the proposed wind turbines are set out in Table 4.3.

Table 4-3: Wind Turbine Co-ordinates

No.	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**
X	191738	190860	190657.8	190583	190210.6	190160	189747.4	189604.6
Y	398370	398240	397779.6	397297	397043.4	397408.7	396594.1	396205.3

The main proposed wind farm site and grid connection route lies entirely within County Donegal in the Republic of Ireland. The site of the proposed development lies with Graffy DED. The R253 Regional Road lies to the south of the site. Three lakes, namely Lough Ea,

[3] https://www.cso.ie/en/releasesandpublications/ep/p-cp10esil/p10esil/ilg/

Lough Maddy and Lough Nabrackboy, lie within 1km of the proposed site. Chapter 2 provides a fuller description of the receiving environment.

Map 6.2.1 of the Donegal County Development Plan 2018 -2024 indicates that the wind park development will be located within a rural area classified as 'Structurally Weak'. This evidences, as per the scoio-economic indices summarised in this Chapter that the Graffy area exhibits characteristics such as persistent and significant population decline, as well as a weaker economic structure based on data of income, employment and economic growth.

Local land use is characterised by agricultural farming and grazing at the wind farm site. The proposed grid connection will be installed under public roads and thus the land use in this case is access, transport and recreation.

4.4.2.2 Closest Residences

We initially identified a total of 24 no. 'houses' (noting that some are derelict or long term unoccupied) within 10 times the maximum blade tip height distance (1,496m) of the proposed two turbine models and the proposed wind turbines locations. These are illustrated in the attached House ID Map Figure 4-1. Visualisations from groups of houses representing the appearance of the proposed wind turbines through wireframes are also included from Figures 4-4 to figure 4-14. Many of these houses are financially associated with the proposed wind farm.

The closest inhabited dwelling (H5) is located approximately 623m from the nearest proposed turbine location (T5).

There are 16 no. structures within 1km of the proposed turbines. Several structures within this distance, such as H3, H4, H13, H18 and H22 are derelict buildings. Excluding these structures leaves 9 no. habitable dwellings and 1 recent replacement planning permission (PA Reg. Ref, 21/51392) for H16, within one 1km radius of the proposed turbines (H2, H5, H6, H7, H14, H15, H16, H19, H20 and H21).

Assessments of the potential for the proposed development with the two proposed turbine options to impact on the noise environment of these dwellings and their inhabitants has been assessed (EIAR Chapter 5). No significant adverse impacts have been identified.

In a recent decision on the Meenbog wind farm development at Croaghonagh and Cashelnavean townlands, Co. Donegal (ABP 300460-17), the Board noted the Development Plan requires a setback distance of 10 times the tip height of proposed turbines from residential properties and other centres of human habitation in the interests of residential amenity. This was recognised to be at variance with National Policy as set out in the 2006 Guidelines, which recommends a 500m separation from nearby houses. It is also noted that the Draft Approach to Wind Energy, 2017 states that the '*preferred draft approach' proposed for visual amenity comprises a setback distance, of 4 times the tip height between a wind turbine and the nearest point of the curtilage of any residential property, subject to a mandatory minimum setback of 500 metres.*' This development had several houses located with the 10 times the tip height set back distance required by the Donegal Development Plan (2018-2024). This development was still approved planning permission by the Board.

There are no actual dwelling houses within 4 times the maximum blade tip height distance (598.4m maximum for either turbine model) for the proposed wind turbine locations. The property identified as H4 which is the closest to a proposed wind turbine is a ruined and roofless structure.

The potential for the proposed development to impact on residential amenity and visual residential amenity is considered later in this report.

4.4.2.3 Radon

The Environmental Protection Agency advise on their website that Radon creates the greatest health risk from radiation in Ireland, accounting for more than half of the total radiation dose received by the Irish population. Radon is a known carcinogen, in the same category as tobacco smoke and asbestos and it has been identified as a cause of lung cancer.

The Environmental Protection Agency, Ireland's interactive radon map[4], is based on the EPA radon map of Ireland. The map was produced from a national survey of approximately 11,000 homes. A High Radon Area is any area where it is predicted that 10 per cent or more of homes will exceed the Reference Level of 200 bequerel per cubic metre (Bq/m3). The map indicates the proposed site is subject to elevated radon potential. The development is located within an area where between one and five per cent of the homes are estimated to be above the Reference Level. It is thus not considered to be a High Radon Area. The human health impacts associated with the occurrence of Radon must be considered in relation to enclosed spaces within permanent buildings. The proposed substation will not be "occupied" in a residential sense, and will be visited periodically for routine maintenance.

4.4.2.4 Landfills & Waste Sites

The EPA manage an interactive Pollutant Release and Transfer Register (PRTR) Map,[5] which shows all PRTR facilities reported since 2009. These are facilities that:

(a) carried out a PRTR Activity above the relevant capacity threshold, and

(b) released a PRTR pollutant above the specified reporting threshold and/or transferred waste offsite above the relevant reporting thresholds in a given year.

There are no landfills, intensive livestock production centres or waste storage locations at the site or in its vicinity.

4.4.2.4 Health and Safety

The surrounding context consists of a mix of residential, undeveloped/ agricultural lands. It does not include any waste processing facilities or man-made industrial or manufacturing processes which would be likely to result in a risk to human health and safety.

Safety of the public and staff are of primary importance to the wind park developer and consultants. During site investigations associated with the environmental impact study, appropriate site safety procedures, including relevant COVID-19 restrictions and precautions, have been enforced and followed.

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[4] https://www.epa.ie/radiation/radonmap/ (accessed 19.02.21)
[5] PRTR GIS Map https://gis.epa.ie/EPAMaps/PRTR (accessed 19/02/21)

4.4.3 Population and Settlements

4.4.3.1 Population Change

The census data presented in Table 4-4 shows that between 2006 and 2011 the population of Ireland increased by 8.2%. Analysis of population change in County Donegal over the census periods 2006, 2011 and 2016 demonstrates a growth rate of 9.4% between 2006 and 2011, which is significantly higher than the rate of the State, during the same period (3.8%). The rate of growth over this period was the result of a high level of net in-migration, combined with a steady level of natural increase. But census 2016 data shows that trends changed over the period 2011-2016, during which the population of County Donegal decreased by 1.2% (1,945 persons) to 159,192 persons coinciding with economic downturn and recession. Both the rate of natural increase fell with net outward migration in the County.County Donegal has a highly rural population, with 72.7% of the population living in rural areas, whilst the county's largest urban centre is Letterkenny with a population of less than 20,000. These factors make Donegal vulnerable to rural population decline as major industries are reluctant to move to such rural areas and many of the young are attracted elsewhere by greater opportunities.

Table 4-4 Population Change 2006-2016 (Source: CSO & NISRA)

Area	**Population**			**% Population Change**	
	2006	**2011**	**2016**	**2006-2011**	**2011-2016**
Republic of Ireland	4,239,848	4,588,252	4,761,865	8.2%	3.8%
Northern Ireland	1,743,113	1,814,318	1,862,137	4.1%	2.7%
County Donegal	147,264	161,137	159,192	9.4%	-1.2%
Study Area	6,314	6,665	6,457	5.3%	-3.1%

The population within the Study Area increased by 5.3% between 2006 and 2011, but has decreased by 3.1% between 2011 and 2016.

Table 4-5 Population Change District Electoral Areas within the Study Area 2006-2016 (Source: CSO)

District Electoral Areas (DEDs)	Population			Population Change	
	2006	2011	2016	2006-2011	2011-2016
Ardara	1,052	1,194	1,175	+11.9%	-1.6%
Altanapaste	393	410	398	+4.1%	-2.9%
Binbane	175	150	165	-14.3%	9.1%
Cloghan	852	895	925	4.8%	3.2%
Doocharry	85	85	88	0	3.4%
Eanymore	529	557	517	5.0%	-7.8%
Fintown	316	313	280	-0.9%	-10.5%
Glenleheen	191	179	158	-6.3%	-11.7%
Glenties	1,481	1,508	1,443	1.8%	-4.3%
Graffy	209	181	157	-13.4%	-13.3%
Haugh	233	240	226	2.9%	-5.8%
Lettermacward	679	708	636	+4.1%	-10.2%
Lough Eask	119	245	289	51.4%	15.2%
Total	6,314	6,665	6,457	+5.3%	-3.1%

When the population data is examined in closer detail with the study area it shows that the levels of population change within the Study Area has been unevenly distributed. The DED in which the Proposed Development is located, Graffy experienced an astonishing population decrease of 24.9% between 2006 and 2016, the *highest rate of population decline* within the Study Area.

In comparison, the population of Lough Eask DED has increased by 58.8% in the same time-period. Of the DEDs within the Study Area around the proposed development, the highest population recorded in the 2016 census was in Glenties DED. The town of Glenties is the largest settlement with the Study Area with a population of 805.

4.4.3.2 Population Density

Population density figures for the Republic of Ireland, County Donegal and the Study Area for the 2006, 2011 and 2016 Census are shown in Table 4-6.

Table 4-6 Population Density in 2006, 2011 and 2016 (Source: CSO)

Area	Population Density (Persons per km²)		
	2006	2011	2016
Republic of Ireland	62.0	67.0	69.6
County Donegal	30.3	33.8	33.4
Study Area	8.8	9.4	9.1

The population density of the Study Area in which the proposed wind project site is located recorded during the 2016 Census was 9.1 persons per km^2 (Table 4-6). This figure is significantly lower than the average for the Republic of Ireland which is 69.6 persons per km^2. This figure is also lower than the population density of 33.4 persons per km^2 recorded for County Donegal in the 2016 census.

Table 4-7 Study Area DEDs Population Density 2016 (Source CSO)

District Electoral Division (DED)	Population Density
Ardara	32.0
Altanapaste	5.3
Binbane	3.5
Cloghan	10.2
Doocharry	2.0
Eanymore	18.4
Fintown	7.7
Glenleheen	1.9
Glenties	17.3
Graffy	1.9
Haugh	14.3
Lettermacward	16.2
Lough Eask	5.5

Population density recorded within the Study Area varies between DEDs. Graffy DED, where the Proposed Development is situated, had the lowest population density, at 1.9 persons per km². Ardara DED had the highest population density, at 32.0 persons per km².

4.4.3.3. Household Statistics

Table 4-8 shows the number of households and average household size within the Republic of Ireland, County Donegal and the Study Area during the 2006, 2011 and 2016 Census. The number of households increased between 2006 and 2011 within the State, County and the Study Area. While this continues at State and County level from 2011 to 2016, the number of households within the Study Area decreased slightly.

Average household size recorded within the Study Area during the 2006, 2011 and 2016 Censuses is in line with observations at State and County level during the same period at between 2.6 to 2.8 persons per household.

Table 4-8 Number of Households and Average Household Size in 2006, 2011 and 2016 (Source: CSO)

Area	2006		2011		2016	
	No. of Households	Avg. Size (persons)	No. of Households	Avg. Size (persons)	No of Households	Avg. Size (Persons)
Republic of Ireland	1,469,521	2.8	1,654,208	2.8	1,702,289	2.7
County Donegal	50,415	2.9	57,964	2.7	58,505	2.7
Study Area	2,283	2.8	2,461	2.7	2,437	2.6

4.4.3.4. Age Structure

Table 4-9 shows the percentages of population within different age groups within the Republic of Ireland, County Donegal and the study area recorded in the 2016 Census.

Table 4-9 Population per Age Group in 2016 (Source CSO)

Area	Age Group				
	0-14	15-24	25-44	45-64	65+
Republic of Ireland	21.1%	12.1%	29.5%	23.8%	13.4%
County Donegal	22.0%	11.6%	25.7%	25.0%	15.7%
Study Area	19.8%	10.9%	23.0%	26.9%	19.4%

The Study Area has an older population compared to the national and county average. The highest population percentage occurs within the 44-65 age group (26.9%). The lowest percentage occurs in the 15-24 age group (10.9%).

4.4.3. 5 Settlements

The nearest settlement to the Proposed Development Site is Glenties, located 8km west of the proposed development and Fintown, located 4.2km to the north-east.

Glenties (Na Gleannta) is classed as a medium sized town according to the current Settlement Character Assessment from Donegal County Council. The population of Glenties recorded in the 2016 was 805 compared to 869 recorded in 2011. This is a decrease of 7.4%. The total males recorded was 375 and the number of females was 430.

An important feature of the town is the St Connell's Museum and Heritage Centre which is a repository of items. The museum exhibits include prison cells which were part of the 19th courthouse. Glenties currently has a range of amenities including a post office, a corner shop, a grocery store, several takeaways, cafés and restaurants. The town has a three-star hotel, the Highlands Hotel and several B&B accommodation options.

There is also a health centre, pharmacy, a full time Garda station, and vehicle repair facilities. There is both a Church of Ireland church and a Roman Catholic Church, the latter of which is situated along the N56 as well as St Columbas Comprehensive School, which has over 300 pupils.

Fishing for Salmon, Grilse, Sea Trout and Brown Trout is a popular past-time on the local Gweebarra and Owenea rivers. The Naomh Conaill Glenties GAA Club just outside the town is an important hub for the local community. The town is popular with tourists as a base from which to explore Donegal's west coast and the Blue Stack Mountain Range.

Fintown (Baile na Finne) is a small village on the banks of Lough Finn located to the north-east of the proposed development site and is within the Donegal Gaeltacht. Fintown is classified as a Layer 3 settlement in the County Donegal Development Plan 2018-24. Layer 3 comprises the County's network of smaller rural towns together with their surrounding rural hinterlands. Fintown has a small industrial/commercial estate, new community centre, school, a church, a G.A.A pitch, a library, a public house, a convenience store and a post office. Several business premises have closed in recent times. The village has the only narrow-gauge railway in Donegal which runs along the length of Lough Finn and is popular with visitors.

4.4.3.6. Local services

The local district has few services. Services such as schools, community, sporting and cultural facilities, retail services and public transport access are generally provided in the settlements of Glenties and Fintown.

There is however a church ('Church of the Holy family') 1.8km south of T8 along the R253 with a related hall and also a graveyard in proximity.

Further west also along the R253 there is a public house called the Glen Tavern with a public letter box.

The electrical substation is at Drumnalough west of the site towards Glenties with a communications mast west of the said church.

4.4.4. Local Economy and Industry

4.4.4.1 Local Employment and Industry

The 2016 census indicates that the overall unemployment rate in Ireland fell by 6.1% to 12.9% in 2016 from 19.0% in 2011. When examined at a county level, Donegal showed the largest change, decreasing from 26.2% in 2011 to 18.0% in 2016.

However, when examining the change in unemployment rates by electoral division 2011-2016, the Study Area exhibits a decrease in unemployment between 22.5% and 8.0%.

Employment in rural areas of Donegal is mainly related to agriculture and fishing, whereas the manufacturing industries are largely located in the towns. Indeed the four main employment sectors for Donegal citizens are wholesale and retail, health and social work, education, and industry[6]. Donegal continues to be one of the three worst affected counties in terms of unemployment and has the second worst employment rate in the country, behind Longford.

The main sectors of employment in the study area are Professional Services, followed by Commerce and Trade, Manufacturing Industries, Agriculture, Forestry and Fishing and Building and Construction. Agriculture, Forestry and Fishing and Manufacturing Industries are the only sectors that employ a greater proportion of people within the Study Area than the county and national averages (see Table 4-10).

Table 4-10 Employment by Sector within the Study Area, County Donegal and Ireland (Source CSO)

Industry	Study Area Total employed	Study Area Percentage	Co. Donegal Percentage
Agriculture Forestry and Fishing	185	9.6%	6.8%
Building and Construction	115	5.9%	5.9%
Manufacturing Industries	211	10.9%	9.2%
Commerce and Trade	344	17.8%	20.0%
Transport and Communication	113	5.8%	6.6%
Public Administration	99	5.1%	5.8%
Professional Services	496	25.7%	26.0%
Other	370	19.1%	19.7%

[6] https://www.wdc.ie/employment-by-economic-sector-in-western-counties-whats-happening/#~:text= DonegalSocial%20Wor k%2C%20Education%20and%20Industry. Accessed 05/08/20

The national economic context demonstrates a return to economic growth together with a period of uncertainty in light of the UK's decision to leave the EU. A collaborative response to Brexit is being undertaken by Donegal County Council and Derry City & Strabane District Council. Significant work has been undertaken to consider the challenges and opportunities that are presented. The outputs of this work to date demonstrate that there is an even greater imperative to ensure that key, regionally significant growth priorities are realised.

The restrictions on social and economic life, put in place to protect public health during the ongoing 2020/2021 Covid-19 pandemic have been wide-ranging and the impacts to the economy, and to the health and wellbeing of the Irish population are not yet clear.

Global trade and travel patterns may be disrupted for some time in the aftermath of Covid-19 and economic indicators have suggested an economic recession is on the horizon. Recessions can exacerbate existing inequalities in health and wellbeing. For example, evidence from the Growing Up in Ireland study has shown that the 2008 financial crisis was associated with a deterioration in child physical and mental health, and particularly among those who were socio-economically disadvantaged prior to the crisis. It is not known yet how Covid-19 will effect population growth or migration. This will become evident in coming years.

The Donegal Development Plan 2018 – 2024 strives to strengthen rural communities by supporting agricultural-diversification, tourism and opportunities for rural economic development of an appropriate nature and scale, where local employment opportunities can be provided. The proposed Graffy Wind Energy and Grid Connection Project provides employment opportunities, rural economic development and diversification of an appropriate nature and scale. It will provide a development opportunity for the harnessing of local resources for significant environmental and economic gain as well as direct financial benefits to the local population in the form of a linked community fund.

4.4.4.2 Deprivation

The Pobal HP Deprivation Index a census-based deprivation index for the Republic of Ireland and it is the main index used in Ireland and applied by government departments, state agencies, voluntary and non-governmental organisations.

Overall, the Border Region is the most disadvantaged region of Ireland, and County Donegal is the most disadvantaged local authority area within the region. Like any other part of the country, Donegal has been massively affected by the economic downturn after 2007, reflected in the drop in the absolute deprivation score from -7.1 in 2006 to -13.2 in 2011. This represents a drop of 6.1, compared to a nationwide drop of 6.5. This also implies that the relative position of Donegal has remained unchanged, being the second most disadvantaged local authority area in Ireland.

Of the 149 DEDs that make up County Donegal, more than two-thirds of DEDs (104) are marginally below the average, another 35 EDs are in the 'disadvantaged' category and two DEDs are very disadvantaged. Only eight EDs, just over five per cent of its areas are above the national average. Of these, seven are marginally above the average while one ED falls into the 'affluent' category.

Deprivation levels vary within the study area. The DEDs are Doocharry, Glenleheen and Binbane are *among the most disadvantaged in the whole of Donegal County*, recording absolute deprivation index scores of -25.5, -16.4 and -15.8 respectively in 2011. Doocharry DED is one of only two DEDs in Donegal that are in the 'very disadvantaged' category. In contrast, Lough Eask is the only DED in the Donegal County that falls into the 'affluent' category with an absolute deprivation score of 11.1 recorded in 2011.

In the most recent index based on the 2016 Census, Lough Eask was still the most affluent DED in Donegal with an unemployment rate of 3.13% for males and 2.63% for females and 41.9% of residents having third level education. Doocharry was only DED within the Study Area deemed 'very disadvantaged' in 2011. Altogether, Donegal has marginally higher deprivation level than Ireland as a whole. The general trends of the data are that affluence is highest in the urban peripheries and gradually declines as you move into rural locations. The relative distribution of disadvantage and affluence in Donegal has remained largely the same in the ten years from 2006 to 2016.

4.4.5. Land use within study area

Farmland makes up 43% of the total land area of County Donegal. The majority of this farming occurs in the river valleys and rolling lowlands of the east and south of the county. Farming in the county is dominated by beef and sheep which together make up nearly 75% of Farm types. There are 3,462 Specialist Beef farms in Donegal which is 37.5% of all farms in the county and almost one-fifth of Ireland's sheep farming enterprises are based in Donegal.

Table 4-11 Farming Types within Donegal 2010 (Source CSO)

Farm Type	Number of Farms	Percentage
Specialist Tillage	141	1.5%
Specialist Dairying	180	1.9%
Specialist Beef Production	3,462	37.5%
Specialist Sheep	3,393	36.7%
Mixed Grazing Livestock	1,163	12.6%
Mixed Crops and Livestock	140	1.5%
Mixed Field Crops	704	7.6%
Other	57	0.6%

The site of the proposed development is located in an upland mountainous area of 1,200 OD to 310 OD between the valleys of Stracashel and Stranagoppoge Rivers and along the foothills of Aghla Mountain. Some of the site is in the catchment of the Owenea River.

The Proposed Development Site is located within the Bluestack Landscape Character Area (LCA) which is a landscape dominated by vast areas of upland mountains, bogs and lakes. The area is traversed by popular walking trails through the Bluestack Mountains. Mountain lakes and rivers, particularly the Owenea River are popular fishing locations.

Farming is limited to marginal farming with rough grazing at very low stocking levels. Peat cutting would have traditionally been carried out in the area. There are numerous large coniferous commercial forestry blocks in the locality. Population density is low and houses are generally dispersed, isolated one-off dwellings with the occasional farmstead. These dwellings are located on the lower slopes of mountains and on river plains. Many are now unoccupied or derelict. Overhead electricity lines with metal pylons are situated along the southern valley.

4.4. 6 Recreation and Tourism

Tourism

This aspect of the EIAR has been assessed in accordance with the guidance contained in the Bord Fáilte's "*Guidelines on the treatment of tourism in an Environmental Impact Statement*"[7] and examines those aspects of the proposed Graffy Wind Energy and Grid Connection Development which may potentially impact tourism (i.e. the quality of a destination or a tourism activity) in the locality and region. It is noted that wind farms and their associated infrastructure are not project types described as an example in this guidance. However, it is anticipated that potential impacts of wind farms on tourism would be on landscape character, visual amenity ,tourist perception of the area and visitor experience.

Donegal has a reputation of delivering world-class tourist services and attracting visitors from all over the island of Ireland, as well as many overseas destinations including the UK, USA and mainland Europe. Donegal's tourist industry supports over 29,000 jobs in the North-West region of Ireland. Donegal County Council Tourism Strategy 2017-2020 identifies tourism as a key driver of sustainable economic growth, job creation and social well-being in the county. In 2011, over 20% of new enterprises in County Donegal were in the tourism sector. The most recent Fáilte research shows that overseas visitors tend to come to the region either on holiday or to visit friends and family. Visits to friends and family account for more than half (57%) of British visitors. Holiday is the dominant reason for travel to the region. In tourist surveys in 2013, visitors cited that their main reason for visiting Donegal was the beautiful scenery (26%) and history/culture (11%).

Main Attractions

County Donegal has a variety of tourist attractions, including:

- Wild Atlantic Way
- Malin Head, the most northerly point of Ireland's mainland and filming location used in Star Wars: The Last Jedi

[7] http://www.yellowriverwindfarm.com/files/EisAppendices/Appendix%20F%20-%20Statutory%20&%20Non-statutory%20Consultees/02.%20F%C3%A1ilte%20Ireland%20EIS%20and%20Tourism%20Guidelines%202011.pdf Accessed 11/08/20

- Glenveagh National Park
- Mountain ranges including the Bluestacks, Seven Sisters and Derryveagh Mountains; the latter includes Mount Errigal
- The Gaeltacht, a primarily Irish-speaking region of cultural significance and frequented by tourists
- Donegal Islands, along the coast which may be accessed in boat journeys from Donegal's port and harbour towns
- Ecology and Conservation: Donegal's bog and peatland environments are of particular interest as are Donegal's forest and woodland areas (higher than average land coverage of forest and woodland areas)
- The numerous towns and villages of Co. Donegal, each with unique character, charm, and history, which present opportunity for heritage-focused tourism.
- Grianán Na Aileach, a stone ringfort, thought to have been built by the Northern Uí Néill, in the sixth or seventh century CE[8]; the seat of the Kingdom of Ailech and one of the royal sites of Gaelic Ireland. Substantial restoration work was carried out in 1870. Today, the site is an Irish National Monument and a tourist attraction.
- Various festivals

Food Tourism

Donegal is developing a reputation as a producer of high-quality foods as well as offering a range of excellent restaurants and artisan food producers. Donegal Town won the '*Foodie Town Award'* in 2019 on the back of the very successful '*A Taste of Donegal Festival'* which attracted domestic and overseas visitors to sample what local restaurants, hotels, food, drink and lifestyle products Donegal has to offer.

Film Tourism

Donegal has played host to a number of high-profile films in recent years including Star Wars, A Shine of Rainbows and 48 Angels and Grabbers. Star Wars especially has a huge global popularity. The locations along the 'Wild Atlantic Way' were used as locations in the 'Last Jedi' including Malin Head and the film has brought Donegal's scenery to the attention of millions across the world and significantly boosted awareness of the '*Wild Atlantic Way'*.

[8] Bartlett, Thomas. A Military History of Ireland. p.37

Culture

Donegal possess a rich and unique cultural tradition. The traditional music of County Donegal is world-famous, there is a Gaeltacht culture and the county has a celebrated literary tradition.

The accessible historical and heritage sites throughout the county are a major draw for tourists and over the last thirty years a dynamic and vibrant contemporary art scene has emerged.

Nature

The west coast of Donegal is a feeding and breeding ground for basking shark, mink whales, dolphins, blue fin tuna and seals. The coastal and inland wildlife of Donegal draws visitors to the county every year.

Golf

Golfing is a popular pastime and attraction in Co. Donegal, boosted by the natural beauty of the area, the regions' golf courses are utilised by both locals and visitors alike. The 2018 Irish Open was held in Ballyliffen Golf Club in Co. Donegal and welcomed over 94,000 attendants as well as world-famous players such as Rory McIlroy and Jon Rahm. Hosting the tournament has since brought this course and the wider region to the forefront of golf discourse and boosted its popularity. Donegal has 17 golf courses, 14 of which are links golf course. There are only 150 links golf courses in the world. Ballyliffin Golf Club was recently voted the best 36-hole links complex in the world in the US Golf Magazine. Donegal's golf courses are globally acclaimed and golf tourism is growing in the county supporting local hotels, B&Bs, restaurants and bars.

There are numerous golf courses within 50 km of Glenties, including Narin & Portnoo Links (12.7km), Ballybofey & Stranorlar Golf Club (38.3km), Letterkenny Golf club (47.9km), Donegal Golf Club (40.8km), and Gweedore Golf Club (43.6km). The Golf course closest to the proposed development site is Narin & Portnoo Golf Club located adjacent the Narin Beach on the west coast of Donegal, six miles northwest of Glenties, eight miles north of Ardara. The course is over 100 years old and is renowned for its spectacular scenery, and the local area for its hospitality.

Walking

Donegal is a very popular destination for foreign and Irish tourists and visitors alike, as it is well known for its beautiful, rugged scenery; indeed the county's landscape and natural beauty scores as the top reason tourists choose to visit the region.

In 2017, the number of overseas tourists in Donegal reached 255,000, which represented the highest figure for any region in the northwest. These visitors spent a reported €82 million in the county, which contributed to the total combined spending of €4.9 billion throughout Ireland[9].

The most visited attractions in county were Glenveagh National Park (34%) Sliabh Liag (29%) and Inishowen (18%). The most popular activities while holidaying in the Donegal are identified in Table 4-12.

Locations that are particularly popular with hikers include Loch Eske, peaks within the Bluestacks Mountains including Carnaween, Lugnabrogue and Doobin, the Owenea River and Dissert (an early ecclesiastical site). All of these locations are south of the proposed development site. There are numerous trails in the Glenties region, including the Bluestack Way, the Gap trail, and the Slí na Finne loop, which passes close to the proposed wind farm development site. These routes allow hikers to take in the wilderness, mountains, glens, lakes and rivers that characterise the landscape of central Donegal. The area in close vicinity to the proposed development is less popular with hikers.

Table 4-12: The most popular activities for those on holiday in Co. Donegal (Source Fáilte)

Activity	% of tourists engaged	National Average
Hiking and Hillwalking	42%	20%
National Park	32%	20%
Traditional Music and Dance	24%	18%
Water-based	10%	3%

[9] https://www.failteireland.ie/FailteIreland/media/WebsiteStructure/Documents/3_Research_Insights/2_Regional_SurveysReports/2017-topline-regional-tourism-performance.pdf?ext=.pdf. Accessed 07/08/20

Fishing

Fishing on the local Gweebarra and Owenea Rivers is a popular activity for visitors to the area in the summer months. The Gweebarra River is a 20-mile-long stretch of Spate River flowing from Lough Barra to Gweebarra Bay. The river has a good run of fish including salmon, grilse and sea trout.

The Owenea River runs for 13 miles draining Lough Ea in the west of the Croaghs, into Loughrosmore Bay at Ardara. It is one of the best salmon rivers in the county. The rivers also has a run of grilse, sea trout and a resident stock of brown trout. The fishery is well-managed with good facilities for visitors. The Owenea Fishery Office on the Mill Road south of Glenties provides facilities for visiting anglers to acquire permits and equipment as well as toilets and hospitality. These river runs are attractive to anglers because of their location in the scenic and unspoilt countryside of Donegal.

Tourist Amenities and Attractions in proximity to the proposed development area

The study area contains a number of tourist amenities. The Fintown Railway is the only operational narrow-gauge railway in Donegal and dates back to the 18th century. A restored 3-mile section of the line takes visitors from along the shores of Lough Finn 2.8km north of the proposed development area.

There are a number of B+B/Air B+Bs in the study area. The town of Glenties has a hotel (The Highlands Hotel), a hostel, and 4 no. B&Bs (Marguerite's B&B, Brennan's B&B, Avalon B&B, Station House B&B), as well as a museum (St. Connell's Museum and Heritage Centre) which would be of interest to visitors.

There are no key points of interest identified relating to the proposed development area itself, apart from a local waymarked Fintown walk. The area in close vicinity to the proposed development is less popular with hikers. The general attraction of the region's natural landscape suggests that there are opportunities for the area to be utilised for general outdoor recreation.

4.5. Potential Impacts

This section provides a description of the impacts that the proposed development may have during the construction, operation and decommissioning phases. The assessment of impacts on population and human health addresses potential for impact to Socio-economic considerations, Access and Traffic, Tourism, Noise, Shadow Flicker, Air Quality and Climate, Residential Visual Amenity, Health and Safety issues and environmental hazards.

4.5.1. Employment and Financial Benefits

General

The proposed Graffy Wind Energy and Grid Connection Project has the potential to result in a beneficial impact on the local economy through the provision of jobs for local people and contracting companies during the construction phase. The proposed development is likely to:

- Bring investment into the local community.
- Benefit local businesses in the service sector (e.g. accommodation providers, local food outlets, shops, etc.)
- Provide employment opportunities for local material suppliers, quarries and construction firms.

Contribution to European, National and Local Policy Objectives

The Irish government has committed to a low-carbon pathway in order to meet future 2030 and 2050 targets. As a member of the EU, Ireland has agreed to an EU-wide 40% reduction in greenhouse gas emissions by 2030 and a reduction of 80-95% by 2050 compared to 1990 levels.

In March 2019, the Joint Oireachtas Committee on Climate Action published its cross-party report entitled: Climate Change: A Cross-Party Consensus for Action. The report set out 42 priority recommendations in the area of climate action, including a target for 70% renewable electricity in Ireland by 2030. Ireland's Climate Action Plan was published in June 2019 formally adopting the 70% renewable electricity target.

Ireland's Climate Action Plan states that an increase electricity generated from renewable sources to 70%, will be indicatively comprised of up to 8.2 GW total of increased onshore wind capacity. This is compared to 3.5 GW total of offshore renewable energy and 1.5 GW total of grid-scale solar energy.

Onshore wind has been the largest contributor to the growth of renewable energy in Ireland in the last 10 years. Onshore wind contributed 81% of Ireland's renewable electricity in 2014. Ireland's Transition to a Low Carbon Energy Future 2015-2030 White Paper states the onshore wind will continue to make a significant contribution as the most cost-effective technology available to meet short-term targets.

The Donegal County Development Plan 2018-2024 states as the aim of the Council's policy regarding Energy (Section 8.2) is "*to facilitate the development of a diverse energy portfolio by the sustainable harnessing of the potential of renewable energy*" and "*to facilitate the development of Donegal as a Centre of Excellence for Renewable Energy.*"

The proposed development will make a positive contribution to renewable electricity and greenhouse gas emission reduction targets and as such is compliant with European directives, national government strategies and local policy objectives.

Financial Benefits

The proposed development has the potential to have a beneficial impact on the local economy through the provision of jobs for local people and contracting companies during the construction phases. The development will:

- Bring investment into the local community;
- Benefit local businesses in the service sector (e.g. accommodation providers, local food outlets, shops, etc.); and
- Improve local road infrastructure.

The wind energy project will require a significant investment during the development and construction phases as well as continuing costs during the operational stage. It is estimated that in total, the capital Expenditure for the Windfarm delivery is projected at €45 million, including contingencies. This represents a major private investment into the local, Donegal and Irish economy, of particular importance in the current recessionary economic climate resulting from the COVID pandemic and the unique challenges County Donegal is facing as a result of Brexit.

A report published by Deloitte in 2009 entitled '*Jobs and Investment in Irish Wind – Powering Ireland's Economy*' estimates that between 25 and 30% of capital investment in renewable energy is retained in the local economy. Applying its own actual figures, the developers calculate the benefit to be retained in the local community from this project to be €13.5 million.

A cost-benefit analysis of wind energy in Ireland commissioned by the Irish Wind Association was published in 2019. The report used 'Baringa', an advanced modelling technique to analyse Ireland's electricity market from 2010 to 2020 and simulated how the market would have behaved without wind energy in the system. This analysis was the first time research has been carried out using historical data to carry out a cost-benefit analysis of wind energy. The analysis indicated that the deployment of 4.1 GW of wind generation in Ireland between 2000 and 2020 resulted in a total net cost to consumers of €63 million, which equates to less than €1 per person per year. The research shows that from 2010-2020 wind energy has delivered a €2.3 billion in wholesale energy cost savings.

A similar study was conducted in Northern Ireland using the same 'Baringa' modelling technique, found that renewable electricity from wind has delivered an annual payback of £4 to every consumer in Northern Ireland from 2000 to 2020.

Employment

The proposed Graffy Wind Energy and Grid Connection Project will create and support employment at local, regional, and national levels, both directly and indirectly, through multiplier effects. Construction will involve employment of a specialist range of workers and professionals. In terms of local employment on a wind farm project of this scale, the proposal holds the greatest potential for employment opportunities during the construction period. The proposed Graffy Wind Energy and Grid Connection Project provides an opportunity for economic advantage, job creation, employment of local labour and the use of local resources associated with construction and development work. Opportunities for engineering (civil, electrical and mechanical), mechanical and electrical contractors, all-be-it in smaller numbers, will result from the long-term operation of the development.

In their 2014 report entitled "*An Enterprising Wind*", multinational conglomerate Siemens in conjunction with the IWEA carried out economic analysis on the potential jobs created by the wind sector in Ireland. The report showed that the Irish wind sector had the potential to create up to 35,275 jobs if the country develops 12,000 MW of wind projects including 4,000 MW for the domestic market and 8,000 MW for export. Even under the most modest projection, if Ireland stuck to its 2020 targets and installed only 4,000 MW of wind farms, it would create 8,355 jobs, which is double the amount employed in the wind energy sector in 2014. In the Irish's Climate Action Plan the government committed to increasing onshore wind capacity in Ireland by 8.2 GW (8,200MW) by 2030. This is just above the middle-range scenario in the 'Enterprising Wind' Report and so it can be expected that this investment will create jobs in excess of 17,084 across Ireland.

The Deloitte report estimates that the wind energy sector in Ireland can support 1.5 jobs per MW. According to IEWA, the Republic of Ireland currently has an installed wind capacity of 4,235 MW. Therefore using the Deloitte estimation, the Irish wind energy sector is supporting 6,352 jobs currently.

A report in 2014 by Pőyry, a global consultancy and engineering company entitled "*The Value of Wind Energy to Ireland*" gave a greater estimation of the job creation prospects from a growing Irish wind energy sector. In what they called a 'Domestic Wind Scenario' where the Republic of Ireland delivers sufficient wind capacity to meet 2020 renewable targets and estimated 5.74 direct jobs would be supported per MW of wind capacity installed plus 0.242 operation and maintenance jobs per MW of cumulative capacity.

The report projects that if Irish wind capacity, grows to reach 3.8 GW by 2020, annual GDP will increase by an average of over €352m over the period 2013 to 2020 and around 1,150 additional jobs will be created in construction, operational and maintenance. The report concludes that:

> *"developing wind capacity in Ireland has the potential to bring both transitional and long-term economic benefits. In the transition phase, investment in new sites will create jobs in the construction and engineering sectors. In the long term, the benefits will come from higher exports of electricity to GB."*

The project will also contribute to an upskilling of the local labour market. Killybegs, Co. Donegal has become a centre of excellence in training for the wind energy industry and in September 2013, Letterkenny Institute of Technology (LYIT) and Safety Technology Ltd.

launched a new programme of training which will enhance the employability of LYIT wind technician graduates to prepare them for employment in the sector across Europe.

Rural Diversification

The proposed Wind Farm and grid connection proposal will contribute to rural diversification which is a common government and EU rural development policy objective and as also expressed in the County Development Plan. Wind farms present an alternative and complementary use for agricultural land.

Landowner Income

The development will be an alternative source of income for the local landowners who will receive an annual payment from the lease of the lands under the proposed project over its 25-year lifetime. This offers long term income certainty for these rural landowners. Rent payable to local landowners is estimated at approximately €200,000 per annum, and €5 million over 25 years.

Rates

Local Authorities receive annual rates from wind developers with an average of €15,000 per MW. The development will result in rates generation to government during the c.25-year lifespan of the project. Revenues in the Republic of Ireland vary depending on the local authority but generally, assuming 4.48MW curtailed capacity for each turbine installed, each turbine installed could generate approximately €67,200 per annum in total for the local authority. This means that this project has the potential to contribute an estimated €537,600 to the local authority in rates each year. This could contribute a substantial estimated sum of almost €12.6 million over the 25-year operational lifetime of the project, based on these figures.

Community Fund

The developer is committed to contributing to a Community Fund. This find will receive an annual contribution in the order of €200,000 per Annum. Details of the fund and what it will cover will be drawn up to the agreement of the local council and relevant stakeholders following planning approval for the proposed development.

The direct financial benefits of the wind park proposal both annual and once off would total €24.16 million over 24 years. These are summarised in the following table.

Table 4-13: Summary of estimated financial benefits arising from the proposed development

Financial Benefit	**Rate**	**Annual Contribution**	**Estimated Contribution over 25 years operational period or once off**
Commercial Rates	Estimated @ €15,000 per MW	€537,600 Per Annum *(assuming turbines of 4.48MW nominal generational capacity)* [10]	€13,440,000
Once-off Development Contribution to Local Authority	€2,000 per 0.1MW (DCS 2016-21)	-	€720,000 (tenth of MW rounded to 45 no.)
Community Benefit Contribution	-	In the order of €200,000 Per Annum	€5,000,000
Rent payable to local Landowners		c. €200,000 per Annum	€5,000,000
Estimated direct financial Wind Park benefits: once off and over 25 years			**€24.16 million**

4.5 2. Carbon Footprint

In August 2019, the Department of Communications, Climate Action and Environment published the *Climate Action Plan (CAP)*, which noted key targets including an aim of Ireland achieving 70% renewable electricity by 2030. The CAP illustrated how Ireland's make-up of

[10] The proposed turbines Nordex 133 has a potential 4.8MW but this is curtailed as the 8 turbine project power output is capped at 35.88MW due to grid connection capacity.

greenhouse gas emissions differ from most other European countries due to the state's large meat and dairy market for exporting. As a result, agriculture comprises 32% of emissions from Ireland compared to just 11% from the same sector in the rest of Europe[11]. In light of these figures, engaging with renewable energy is necessary. Wind energy is seen as the key to help boost Ireland's renewable energy sector as wind energy is the fastest and most economical to put into operation, as well as being a rich resource in Ireland (particularly in the North West). As such, Donegal is ideally situated to take advantage of this resource which provides the county with an opportunity to development as a hub for research and emerging technology[12]. The National Climate Change Strategy 2007-2012 identified renewable sources as the most effective approach to reducing Ireland's greenhouse gas emissions. The proposed Graffy wind farm development will contribute to this target, and so will have a long-term positive impact.

Further discussion of the impact of the proposed development on Air and Climate is provided under the separate EIAR chapter 9.

4.5.3. Tourism and Wind Energy

Fáilte Survey 2007

In 2007, Fáilte Ireland undertook a survey involving face-to-face interviews with 1,300 tourists both domestic (25%) and overseas (75%). The survey included 1,000 visitors to the Republic and 300 visitors to Northern Ireland. Their aim was to assess the attitudes of visitors on wind farms in Ireland and how seeing wind turbines in the landscape impacted their enjoyment of Ireland's scenery. They found that almost half of tourists interviewed had seen at least one wind farm on their holiday. Of those that encountered a wind farm, most felt that their presence did not detract from the quality of their sightseeing, with 45% saying that the presence of the wind farm had a positive impact on their enjoyment of sightseeing and only 15% claiming they had a negative impact.

Fáilte Survey 2012

[11] Government of Ireland. (2019). Climate Action Plan 2019. https://assets.gov.ie/25419/c97cdecddf8c49ab976e773d4e11e515.pdf
[12] Donegal County Council. (2018). County Donegal Development Plan 2018-2024. http://www.donegalcoco.ie/media/donegalcountyc/planning/pdfs/viewdevelopmentplans/countydonegaldevelopmentplan2018-2024/partaandb/Document.pdf

Wind farm construction accelerated in Ireland between 2007 and 2012. Therefore Fáilte updated their research in 2012 to determine whether there had been any changes to visitor attitudes. The number of tourists that said they had seen a wind farm whilst on holiday had risen to 56% from 49% in 2007. The research indicated an increased polarisation in attitudes. Visitors who said the wind farms has a positive impact increased to 47%, while negative responses increased as well to 30%. In both 2007 and 2012, most wind farms were seen by visitors from their car. The study states that:

> *"Seven out of 10 (or 71%) of visitors claim that potentially greater numbers of wind farms in Ireland over the next few years would have either no impact or a positive impact on their likelihood to visit Ireland."*

The survey results suggest that in landscapes other than those of national scenic importance, the development of wind farms can have a positive impact in terms of the visitor's perception of the Irish landscape and of Ireland's commitment to renewable energy.

Northern Ireland

The Northern Ireland Tourist board published a document entitled "*Wind Farms and Off Shore Wind Farms*" in 2011 which aimed to provide an insight into the impact wind farms have on tourism. The results showed that only 5% of domestic tourists and 3% of tourists to Northern Ireland from the Republic of Ireland would avoid returning to areas that had wind farms. Similarly, 52% of domestic tourists and 48% of tourists from ROI stated that they would be happy to visit an area that has wind farms.

Scotland

Research investigating tourist attitudes to wind farms and their effect on tourism was carried out by VisitScotland in 2012. The study involved the interview of 3,000 visitors to Scotland. The key finding was that 83% of respondents stated their decision to holiday in Scotland would not be affected by the presence of a wind farm and 80% did not agree that wind farms spoil the look of the Scottish countryside. In fact, almost half expressed interest in visiting a wind farm development if it included a visitor centre.

Indeed, the Whitelee Wind Farm near Glasgow invested £2million in a visitor centre that saw 120,000 visitors, 4,500 from local schools, in the first twelve months. Habitat suitable for Red and Black grouse was also developed adjacent to the site, protecting these species and providing opportunities to attract bird watchers.

Graffy Wind Farm, County Donegal

In 2007, Glasgow Caledonian University was commissioned to assess whether the government priorities for wind farms would a positive or negative impact on the Scottish tourism industry. Their research included a desk-based review of 40 studies in the UK and Ireland, in addition to reports from Australia, Denmark, Germany, Norway, Sweden and the United States as well as face-to-face and internet surveys.

Of those surveyed 75% of tourists felt wind farms had a positive or neutral impact on the landscape, of which:

- 39 per cent of respondents were positive about wind farms.
- 36 per cent had no opinion either way.
- 25 per cent were negative (including 10 per cent who were strongly negative).

The report stated that:

> *"The vast majority (93-99%) of tourists that had seen a wind farm in the local area suggested that the experience would not have any effect on their decision to return to that area, or to Scotland as a whole."*

The studies summarised above demonstrate that there is no conclusive evidence that wind farm development have any adverse impact on local tourism. Tourists are broadly positive about the presence of wind farms in Ireland and negative perceptions can be minimised through good planning with reference to the Department of Environment, Heritage and Local Government's '*Planning Guidelines on Wind Energy Development*' at every stage of the process.

4.5.4. Wind Power and Public Opinion

Various surveys have been carried out to explore public attitudes towards wind farm development. Of all those surveys reviewed, a majority of respondents indicated a high level of satisfaction with wind farms. This is particularly evident after the turbines are operational.

IWEA Interactions Opinion Poll on Wind Energy 2020

A survey of Irish adults was conducted between 2017 and 2019, by the Irish Wind Energy Association concerning the development of Windfarms in their local area.

The key findings were as follows:

- 4 in 5 of those surveyed are in favour of wind power in Ireland.
- Of those in favour 3 in 10 mentioned that using wind power helps the environment. Just under 1 in 5 referred to ready availability, and the same number favour the renewability aspect of wind power.
- Just over half would favour of having a wind farm developed in their local area. However, about 1 in 6 would be opposed with just marginally higher opposition in rural areas.
- Social responsibility features significantly in reasons for favouring – cited explicitly by 1 in 8. 1 in 4 cited environment, while 1 in 6 feels they have no justification for being against wind energy.

How the Irish Public View Wind Farms in the Landscape 2016

MosArt Landscape Architects followed on from this with their investigation of "How the Irish Public View Wind Farms in the Landscape". MosArt's findings show that more than three quarters of Irish people are either positively or neutrally disposed towards wind farms, irrespective of landscape type. Their findings also show that Irish people would prefer two smaller developments to one large wind farm development and that larger turbines are preferred to smaller turbines as fewer numbers of turbines are needed to produce the same amount of energy.

Ipsos MRBI Survey 2016

A nationwide survey conducted by Ipsos MRBI in February 2016 found that 70% of people were directly in favour of wind energy in Ireland, with only 10% opposed.

Based on these studies, it is apparent that many people are favourably disposed towards the generation of renewable electricity by wind turbines and to the presence of wind farms in Ireland. Evidence would further suggest that such disposition becomes more favourable when the wind farms became operational.

The views of the people living in the vicinity of the Proposed Development are detailed in Community Consultation section.

Public Access and Recreational Use

The proposed development lands are in private ownership.

There are no rights of way over the land. Public access to the site is not currently permitted. The site will not be used for public recreation during the construction, operational or decommissioning phases of development.

Tourism

The site is not known to hold any particular features or amenities of interest for tourism or recreation. Construction works at the site will not limit tourism or recreational activities in this area.

The wind farm holds potential to impact on the tourism industry of the local area by virtue of potential disruption to local roads and traffic in this local area during the construction phase. This will be managed in agreement with the local Roads office and in accordance with a Traffic Management Plan, to minimise disruption to the users of local roads during the project construction phase, anticipated to last 12 months.

Once the construction phase is complete the amount of traffic approaching the site will be much reduced, and as such will not result in any potential for disturbance or delay to the users of local roads including tourists.

The construction of the wind farm is therefore predicted to have a negligible potential to impact on tourism in the local area.

4.5.5 Health and Safety

There are no specific safety considerations in relation to the operation of wind turbines. Wind turbines are designed to operate at a high standard of safety. Fencing around turbine towers and other access restrictions will not be necessary. People and animals can walk to the base of turbines structures without being in danger. Any injuries and fatalities in the global wind energy industry have been due to maintenance operatives failing to follow safety guidelines, failure to observe manufacturer and/or operator instructions. There are no known recorded incidents of any injuries to the public as a result of the presence or operation of a wind farm.

Maintenance and protection of health and safety of public and staff is of primary importance to the wind farm developer and consultants. During site investigations associated with the environmental impact studies and surveys, site safety procedures have been enforced and followed. Health and Safety provisions and procedures applicable during wind farm Construction will be covered in the Construction Environment Management Plan. Further Health and safety plans will cover the Operation and Maintenance of the wind farm development. Safety and Health avoidance and limitation measures will be drawn up to cover all aspects of the construction and operation of the Graffy Wind Energy and Grid Connection Project.

The construction and operation of a wind farm developments could pose a safety risk if not managed and maintained correctly. Health and safety procedures to cover the construction and subsequent operation of the development will be drawn up in the pre-construction phase and will be enforced to ensure the health and safety of all personnel and members of the public. All site personnel will be provided with full safety training to ensure minimal risk of accidents.

No conclusive evidence has been presented on the potential link between turbine proximity and adverse impacts to human health, mental well-being, educational disadvantage or detrimental effect on nearby resident populations, young or old. Peer-reviewed research has generally not found strong supporting evidence for claims that negative health effects result from living in close proximity to wind turbines. A key formal publication rejecting wind turbine syndrome, noting the lack of any direct link between wind turbines and health, is the report published by Renewable UK entitled '*Wind Turbine Syndrome – An independent review of the state of knowledge about the alleged health condition*', July 2010[13]. This report contains three separate reviews carried out by independent experts in an effort to update the existing scientific knowledge surrounding infrasound generated by wind turbines. The report was created in response to Dr Pierpont's 2009 book '*Wind Turbine Syndrome*', which garnered significant media attention upon its release. The 2010 Renewable UK independent review found that the methodology and assessment of Dr Pierpont's work were significantly flawed and thus the variety of symptoms listed could not be reliably attributed to wind turbine noise.

[13] Renewable UK. (2010). 'Wind Turbine Syndrome – An independent review of the state of knowledge about the alleged health condition'. http://www.burnley.gov.uk/attachments/APP20130381_013%20038%20Renewable%20Energy%20Paper%20on%20Wind%20Turbine%20Syndrome.pdf

In a similar vein, the American Wind Energy Association and Canadian Wind Energy Association undertook a study entitled: '*Wind Turbine Sound and Health Effects – An Expert Panel Review*'[14], published December 2009. The expert panel found similar results to Renewable UK's 2010 study, noting that the there is no evidence to suggest that the sounds produced by wind turbines – both audible and sub-audible – have any direct negative physiological effects on humans. The panel emphasised that the symptoms seen in '*Wind Turbine Syndrome*' are indicative of the typical stresses of everyday life and can be found throughout the general population, not just those who live close to turbines. These include headaches, anxiety, insomnia, dizziness, etc. Lastly, the panel also highlighted that wind turbines are not unique in making low-frequency 'infrasound'; vehicular traffic and home appliances – amongst other things – also produce this sound and similarly do not convey any harmful risk.

Public Access

Public access to the site will be limited. The site entry will be gated and managed to facilitate entry to authorised and identified persons only. Where appropriate visitors and staff members will be inducted to site safety provisions and issued with appropriate equipment.

Reflected Light and Driver Distraction

Turbine blade, nacelle and tower structures will be finished in a grey semi-matt finish. Thus, it is unlikely that turbine blades or towers will give rise to nuisance from reflected sunlight. Evidence from operational wind farms in Britain indicates that wind farms do not result in significant driver distraction.

It is anticipated that driver distraction in relation to the proposed Project will also be negligible. Glint effects from the turbine blades are not likely since the turbines are a sufficient distance from major and minor roads and dwellings. Turbines will also be coloured Matt grey to minimise this effect.

The turbines may create an initial distraction to motorists and the local population for a time following their erection, however this is likely to be only in the initial months following

[14] American Wind Energy Association and Canadian Wind Energy Association. (2009). 'Wind Turbine Sound and Health Effects – An Expert Panel Review'. https://www.novoco.com/sites/default/files/atoms/files/awea_soundwhitepaper_121109_0.pdf

construction. Road users and the local population will become accustomed to the presence of the turbine structures in the landscape over time.

Ice Throw

Generally, no significant risk to health and safety will be caused from operating a wind turbine at low temperatures or in atmospheric conditions that include frost or snow. However under extreme conditions, such as freezing-fog, or when rain freezes on contact with a blade, a layer of ice can form on hard surfaces, which could include the external parts of the blades.

Given the location and elevation of the proposed Graffy wind turbines, it is not considered that icing on blades represents a significant risk. Instrumentation on the turbine blades prevents ice forming. Any ice formation is likely to cause an imbalance on the rotating blades which would automatically result in shutdown/ cut out of the relevant turbine. For these reasons, ice throw is not considered a significant safety concern.

Public safety and enjoyment of the local area

In addition, the following points are made in relation to public safety and enjoyment of the local area:

- Traffic and Turbine Delivery

  It is not considered that members of the public and local residents using the local road network near the site will be significantly impacted by the proposed development, following the application of the mitigation measures outlined in the Traffic and Access Chapter of this EIAR, during the construction phase of development.

  During the operational phase of the development, trips to the site will be significantly reduced and will consist mainly of routine inspections and maintenance visits. These visits will have a negligible impact on local traffic. The overall impact of the Project is deemed to be of *moderate-slight significance*.

- Air quality

  The proposed development will contribute to the improvement of air quality by the displacement of energy generated from the combustion of fossil fuels. The renewable energy generated will contribute to the avoidance of air pollution which would have been created had this energy been generated from the combustion of fossil fuels.

Dust management measures, as identified under the Air and Climate Chapter of this EIAR, will reduce the potential for fugitive dust particles to cause a nuisance during the construction phase of the development.

4.5.6. Accidents / Unplanned Events / Climate Change

Consideration has been given to the effect of the development on population and human health, and effect of the human environment on the development, in the event of accidents, unplanned events and climate change. The following table considers potential Accidents / Unplanned Events / Climate Change.

Table 4-14: Assessment of Accidents / Unplanned Events / Climate Change

Group	Accident Type	Potential Location Risk	Comment
Geophysical	Earthquake	No	Negligible tectonic activity in the region. Insignificant risk of earthquake, volcano, or tsunami at this location.
	Volcanic		
	Tsunami		
	Landslide	Yes	Consideration of ground stability has been undertaken and is included under Chapter 7.
Hydrological	Avalanche	No	Topography and climate do not support these conditions.
	Coastal Flood	No	Coastal flooding does not affect the development due to the site being a significant elevation above sea level and distance from the coast.
	River Flood	Yes	Considered further in Chapter 8. No significant risk.
	Surface Flood	Yes	
Climatological	Drought	Yes	This is considered in greater detail in Chapter 8 and is not considered to hold potential for significant impacts to population or human health.
	Extreme Temperatures	Yes	In the Co. Donegal setting, temperature extremes would not be of such severity to affect the human environment or the proposed development. Turbine blades are designed to prevent ice build-up during extended periods of sub-zero temperatures.
	Wildfire	Yes	Appropriate management across the site will make the occurrence of wildfires unlikely, along with any associated risks to the development or to the local population and human health.
Meteorological	Snow	Yes	Extreme snow melt would cause flooding but is unlikely to cause a more extreme flood than the standards of protection in-built to the development. Considered further in Chapter 8. No significant risk.
	Hurricanes	No	Hurricanes / severe storms will result in the shutdown of the proposed turbines. Standards of protection in-

Group	Accident Type	Potential Location Risk	Comment
			built to the development will prevent risk to the development and to population and human health.
	Storm Surge	Yes	Storm surges would not affect the development due to the site being a significant elevation above sea level and distance to the coast.
Biological	Epidemic	Yes	Biological hazards would not affect the development which can be remotely managed and operated.
Man Made	Various	Yes	Man-made hazards in isolation would not affect the population and human health environment. Appropriate provision for safe working and health and safety standards are built into the development design and operational procedures for the development.

4.5.7. Residential Amenity Aspects

General

An assessment was undertaken to consider the potential impacts from the proposed Graffy Wind Energy and Grid Connection Project that may be experienced by residents of properties within proximity to the development. The assessment was carried out in line with the DoEHLG Wind Energy Guidelines (2006).

The Guidelines recognise that "*wind energy development, like all development, has the potential to impact on the natural and built environm*ent". The main impacts on residential amenity that the Guidelines refer to are noise, shadow flicker and visual amenity. These impacts are considered in the sections which follow.

Residential amenity refers to the experience one has in their own home, and is related to the overall environment and atmosphere associated with the dwelling. The quality of residential amenity is shaped by a number of factors, including land-use activities in the area, site setting and degree of peace experienced in the residence.

Planning history searches, desktop mapping and site visit investigations have allowed us to accurately map the locations of all houses within 10 times Rotor Diameter (RD) using the Nordex N133 Option 1 maximum model distance of 1,332m of the proposed wind turbine locations. There are 27 No. structures within this radius of the turbines. Eight of these structures are not occupied and are therefore excluded from consideration in this report. Therefore there are a total of 19 no. dwellinghouses within 10 RD distance of 1,332m of the proposed wind turbine locations. The closest inhabited dwelling (H5) is located approximately 623m from the nearest proposed turbine location (T5). The location of these dwellings including two planning permission sites, are illustrated in Figure 4-1.

We address residential amenity under the following headings of: noise, shadow flicker, property values, TV signals, traffic and turbine delivery. Sub-section 4.5.8 addresses residential visual amenity and overbearance.

Noise

Noise has been assessed according to guidance in relation to wind turbine noise is the Wind Energy Development Guidelines 2006. This guidance has been succeeded by a draft guidelines document released in December 2019. This document has adopted many components from ETSU-R-97 – The Assessment and Rating of Noise from Wind Farms. For the purposes of this report, results have primarily been assessed in line with the draft guidelines, with reference to appropriate aspects of ETSU-R-97

The new draft Wind Energy Development Guidelines (WEDG19) dated December 2019 are an update to the previous 2006 guidance, and impose more stringent regulations, in line with ETSU-R97 – The Assessment and Rating of Noise from Wind Farms.

This guidance has adopted the approach of establishing a Relative Rated Noise Limit (RRNL) from ETSU-R-97. The RRNL is determined through background monitoring before the wind energy development is in operation. The relative rated noise level resulting from the wind energy development and taking into account the cumulative impact of noise levels resulting from the other existing and approved wind energy developments shall not exceed:

- Background noise levels by more than 5 dB(A) within the range 35-43 dB(A), or
- 43 dB (A).

The WEDG19 document lays down the requirements for wind turbine proposals to offer a protection to properties located within proximity to the proposed wind development and effectively produces three separate limit levels depending on the time of the day:

- Night-time (23:00-07:00) limit is background +5dB within the 35-43dB range.
- Evening (19:00-23:00) limit is an additional 5dB on night-time within the range.
- Daytime (07:00-19:00) limit is 10dB on top of night-time within the range.

Where a property is financially involved or associated with a project, the noise limit can be set at 43dB for all periods and wind speeds.

The Institute of Acoustics published a '*Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise*' (IOA, 2013). This good practice guide lays out information on how to competently carry out procedures relating to the assessment of wind turbine noise.

The WEDG19 adapt the approach set out in this guidance, along with international standards and guidance on tonal noise and low frequency noise for wind energy developments in Ireland.

The Wind Energy Development Guidelines published in 2006 by the Department of the Environment, Heritage and Local Government state that:

> *"Noise impact should be assessed by reference to the nature and character of noise sensitive locations."*

The Guidelines define a noise sensitive location in the case of wind energy development, as any location in which the inhabitants may be disturbed by noise from the wind energy development. This incorporates a dwelling, house, hotel or hostel, health building (providing patient services), nursing/retirement home, educational establishment, place of worship or entertainment, or other facility which may justifiably require for its proper use the absence of noise at levels likely to cause significant effects. Their definition also includes areas with protected wildlife, particular scenic quality or special recreational amenity importance.

The 2006 Guidelines state that in general, noise is unlikely to be a significant problem where the distance from the nearest turbine to any noise sensitive property is more than 500 metres.

Irwin Carr Consulting conducted a noise impact assessment for the proposed eight turbine Graffy Wind Farm with two turbine model options, its associated grid connection and haul route. The assessment involved background noise monitoring and wind speed measurements taken at two locations in the vicinity of the site over 15-day period in accordance with ETSU-R-97 requirements and the recommended Wind Energy Guidelines 2019 (WEDG19) methodology.

The report concluded that the highest potential noise levels from the proposed wind turbine comply with the appropriate noise limit for the daytime, evening and night-time periods, as defined by WEDG19 as the appropriate noise limits. A cumulative assessment was also undertaken considering all further proposed, approved and operational wind energy developments within 20 km of the proposed development, where it was confirmed that there was no impact on the predicted noise levels from the two turbine optioons in the wider vicinity of the site.

Potential noise impacts on residents resulting from the Proposed Development are not considered significant and are in compliance with the limits set out in the 2006 Wind Energy Guidelines.

The Noise Impact Assessment of the proposed development are contained in Chapter 5 of the EIAR.

Shadow Flicker

Shadow flicker is an effect that occurs when rotating wind turbine blades cast shadows over a window in a nearby house. Shadow flicker is predominantly an indoor phenomenon, which may be experienced by a viewer sitting in an enclosed room with the flicker effect of the shadow passing the window. Outside, light reaches the viewer from a much less focused source and therefore shadow flicker assessments are typically based on closest residences or indoor workplaces.

The current 'Wind Energy Development Guidelines for Planning Authorities' (Department of the Environment, Heritage and Local Government (DoEHLG), 2006) state that shadow flicker lasts only for a short period of time and occurs only during certain specific combined circumstances, as follows:

- the sun is shining and is at a low angle in the sky, i.e. just after dawn and

- before sunset, and
- the turbine is located directly between the sun and the affected property, and
- there is enough wind energy to ensure that the turbine blades are moving, and
- the turbine blades are positioned so as to cast a shadow on the receptor.

The DoEHLG 2006 wind energy guidelines recommend that shadow flicker at dwellings within 500 metres of a proposed turbine location should not exceed a total of 30 hours per year or 30 minutes per day.

The preferred approach in the review of the 2006 Guidelines (Review of the Wind Energy Development Guidelines 2006 Preferred Draft Approach) is to eradicate shadow flicker altogether. The revised draft of Wind Energy Development Guidelines 2019 outlines that

> "*A condition should be attached to all planning permissions for wind energy development to ensure that there will be no shadow flicker at any existing nearby dwelling or other relevant existing affected sensitive property and that the necessary measures outlined in the shadow flicker assessment submitted with the application, such as turbine shut down during the associated time periods, should be taken by the wind energy developer or operator to eliminate the shadow flicker*".

Therefore, the approach taken in the assessment has been to predict potential shadow flicker occurrence at sensitive receptors, and outline measures to ensure the eradication of this potential effect.

There are no inhabited dwellings within 500m of the proposed wind turbines. The closest inhabited dwelling (H5) is located approximately 623m from the nearest proposed turbine location (T5). H5 is financially associated with the proposed development. All other dwellings are located at distances greater than 623m from the nearest proposed Graffy wind turbines.

The shadow flicker impact assessment has been carried out based on the two turbine model options under consideration for installation at the proposed development site: the Enercon E126 (with a blade diameter of 127m) and Nordex N133 (with a blade diameter of 133.2m). A separate full shadow flicker assessment has been carried out for each model option.

There are 16 sensitive receptors located within the potential shadow zone of the Graffy wind farm, which could experience some degree of shadow flicker from the proposed turbines of this development if N133model turbines were installed, and 14 sensitive receptors which could experience some degree of shadow flicker from the proposed turbines of this development if E126 model turbines were installed.

- If the **N133** were to be installed at the site, **H2 (an associated dwelling)** would have experienced up to a maximum of 72 hours and 59 minutes of potential shadow flicker per year in the worst case scenario. This prediction is now reduced to **12 hours and 51 minutes** per year, with sunshine data factored in.
  In worst case scenario predictions, this dwelling could experience a predicted maximum daily duration of 45 minutes and 37 seconds of shadow flicker. This is reduced to a maximum daily duration of **8 minutes and 2 seconds** of Shadow Flicker per day, with sunshine data factored in.
  All other dwellings will experience less potential shadow flicker than this.

- If the **E126** were to be installed at the site, **H2 (an associated dwelling)** would have experienced up to a maximum of 66 hours and 35 minutes of potential shadow flicker per year in the worst case scenario. This prediction is now reduced to **11 hours and 43 minutes** per year, with sunshine data factored in.
  In worst case scenario predictions, this dwelling could experience a predicted maximum daily duration of 43 minutes and 35 seconds of shadow flicker. This is reduced to a maximum daily duration of **7 minutes and 41 seconds** of Shadow Flicker per day, with sunshine data factored in.
  All other dwellings will experience less potential shadow flicker than this.

. The model results show that in the case of both alternative turbine models, no dwellings is predicted to experience shadow flicker impacts in exceedance of the annual DoEHLG guideline shadow flicker limits of 30 minutes per day or 30 hours per year.

Where significant shadow flicker effects are experienced at a sensitive receptor, possible mitigation measures could include but are not limited to:

- Providing landscaping and other vegetative screening to block or mitigate potential shadow flicker effects and any direct views of the turbines;

- Blinds to be fitted to windows where shadow flicker occurs;
- A multi-directional lighting system could be installed in houses/rooms where shadow flicker occurs, thereby reducing the impact of the shadows cast over a directional light source such as a window.
- Implementation of the shadow flicker shutdown module in the relevant turbine(s), to stop the particular turbine(s) operating during predicted periods when shadow flicker may occur, thus removing potential for this effect on nearby dwellings.

A report by the Massachusetts Departments of Environmental Protection and Public Health entitled '*Wind Turbine Health Impact Study-Report of Independent Expert Panel*'[15], published in 2012, explored the concept of shadow flicker and the extent to which this phenomenon causes harm to humans. The panel found that while shadow flicker can be a nuisance to nearby residents, it is unable to induce seizures as a result of photic stimulation, nor cause any adverse physical health effects.

Property Values

The impact of wind energy developments on the value of real estate in the surrounding area is commonly a cause for concern for local communities. However, numerous studies have found that wind energy projects have little impact on long-term property values.

US Studies

The most comprehensive study of the effect of wind farms on property values has been conducted by the Lawrence Berkeley National Laboratory. Researchers analysed over 50,000 homes close to wind energy facilities across nine U.S states over a 10-year period and found no statistical evidence that operating wind farm had any measurable effect on local house prices. The report author said that "*This is the second of two major studies we have conducted on this topic, and in both studies, we find no statistical evidence that operating wind farms have had any measurable impacts on home sale prices.*"

Another study by the Lawrence Berkeley National Laboratory in partnership with University of Connecticut analysing more than 122,000 Massachusetts home sales

[15] Massachusetts Departments of Environmental Protection and Public Health. (2012). 'Wind Turbine Health Impact Study-Report of Independent Expert Panel'. https://waubrafoundation.org.au/wp-content/uploads/2013/08/MasDEP-wind-health-2-Alves_Pereira.pdf.

between 1998 and 2012, also found no statistically significant evidence that proximity to a wind turbine affects home values.

The University of Rhode Island undertook an assessment of the effect of onshore wind farms on nearby property values in Rhone in 2013. While they could conclude for sure that there is no effect on housing prices, there is no statistical evidence of a large, adverse effect.

Canadian Studies

Research analysing detailed data on 5,414 rural residential sales and 1,590 farmland sales to estimate the impacts of wind turbines on surrounding property values in Melancthon, a rural Canadian township in the northwest corner of Dufferin County, Ontario. The conclusion was that the results did not corroborate with concerns raised by residents regarding the potential negative impacts of turbines on property values.

UK Studies

In the UK, analysis by the Centre for Economic and Business Research has found that wind farms have no negative impact on the prices of property within a 5km radius of the turbines, and that they can even push prices up in some areas. Their analysis was based on 85,000 transactions from 1994 to 2014.

Scottish Studies

With the rise of wind farm developments in Scotland, research was undertaken by ClimateXChange, Scotland's Centre of Expertise on Climate Change. This report aimed to estimate the impact on house prices from wind farm development based on analysis of over 500,000 property sales in Scotland between 1990 and 2014. The report concluded that there was no evidence of a consistent negative effect on house prices, although results varied across different regions in Scotland.

Irish Studies

No research on the effect of wind farms on local property prices has been conducted in Ireland, but according to the Irish Wind Energy Association research from around the world has shown that wind turbines don't negatively impact on property prices.

We cannot conclude therefore that the proposed development including either of the two turbine models will impact significantly on the values of properties in the area.

TV Signals

If, despite precautions, significant signal interference in any form is identified and is attributed to the Graffy Wind Farm turbines, appropriate remedial measures will be undertaken. These modifications may include work on repeater stations, booster units, re-alignment of domestic aerials, installation of higher quality aerials and the installation of suppression equipment. The wind farm developer would undertake the necessary steps to eliminate any signal interference causes as a result of the proposed development.

Traffic and Turbine Delivery

Traffic and road transport issues related to the construction of the proposed development are likely to primarily affect:

- Motorists and other road users.
- Residents living close to the relevant roads proposed as the construction traffic delivery route.
- Residents of local urban centres.

It is inevitable that the delivery of large turbine components on abnormal load trucks will cause some disruption to traffic. Arrangements for abnormal loads will be agreed in advance with the Roads Section of Donegal County Council. Delivery of turbine components will occur outside peak traffic times (i.e. school runs and commuting times).

Increased traffic closer to the site delivering turbine loads and civil works materials may cause disruption to local road users. Field surveys and desktop assessments have been carried out to confirm that the proposed route is feasible to ensure the safe passage of traffic and road users.

4.5.8. Residential Visual Amenity Assessment (RVAA)

Policy and Guidance

Wind turbines, apart from general landscape impacts and visual effects, can have specific impacts on residential amenity such as visual overbearance[16], thus this potential residential amenity impact is now considered separately. Residential Visual Amenity Assessment

[16] For example see N.I planning: Best Practice Guidance (BPG) of PPS 18

(RVAA) has been assessed for dwellings in proximity to the proposed Graffy Wind Park, for the operational stage of the proposed wind farm with reference to the accompanying Annex 4-2 Residential Visual Amenity Assessment.

Residential amenity impacts can be considered as dependent on the scale of the proposed wind turbines and their associated distances from dwelling houses.

The current Wind Energy Development Guidelines 2006 in force do not require a formal assessment of the impacts a proposed development may have to residential visual amenity or visual overbearance to be made.

The government Draft Wind Energy Development Guidelines 2019, noting that this is not the guidance in force, advise in sub-section 6.18 a residential visual amenity setback distance for residential amenity purposes of 4 times the maximum blade tip height tip height should apply between a wind turbine and the nearest point of the curtilage of any residential property in the vicinity of the proposed development, subject to a mandatory minimum setback of 500 metres. Curtilages form part of the dwelling house receptor, as referred in the 2019 Draft Guidance.

The maximum blade tip height of either of the two considered turbine models is 149.6m (N 133) X 4 = 598.4m. There are no habitable occupied houses within this rounded 600m distance at the Graffy wind park. The draft document caveats that this setback requirement is also subject to the need to comply with the strict noise limits laid down in these Draft Guidelines. This is a specific planning policy requirement or SPPR of the Draft Guidelines, noting that they have not been as yet formally adopted.

The Landscape Institute has recently published a guidance note on Residential Visual Amenity Assessment (RVAA)[17]. This guidance note is not prescriptive but promotes a logical approach for assessment of private views and private residential amenity. The RVAA Guidance refers to a 'Residential Visual Amenity Threshold'. This is further elaborated on in Annex 4-2.

[17] https://www.landscapeinstitute.org/technical-resource/rvaa/

In N. Ireland impacts to residential amenity is a consideration for dwellings within X10 times rotor blade diameter distance. In the case of the Graffy Wind Farm, the proposed maximum rotor blade diameter of the two turbine models is 133.2m (N 133), thus the maximum residential amenity sensitivity for this proposal distance is considered 1,332m.

It must be noted that planning permission has existed for some 13 wind turbines on the site, whereas 8 turbines only are now proposed.

Baseline Assessment

The potential for the proposed development to result in residential amenity impacts at proximate houses and one 2021 planning permission for a replacement house that are occupied and within this 1,332m study distance are assessed in this document. Several of these house owners are associated as landowners of the wind farm proposal or are financially associated with the development.

There are c. 19 dwelling houses including one replacement planning permission within this ten times rotor diameter 1,332m distance from the proposed Graffy turbines. Many are financially associated with the proposal, including H5 the nearest house to a wind turbine. The location of these dwellings is as identified in the map of Figure 4-1 utilising Housing Layout (HL) 03. Other buildings have been identified within this distance but these have been excluded for further consideration as they have been identified to be long term unoccupied (e.g. H35, H36) or derelict (e.g. H04), and therefore do not accommodate residents that could experience residential amenity impacts.

Temporary tourism accommodation such as shepherds huts are also discounted from the assessment as they are not dwelling houses. A planning permission approval for self-catering cottage/holiday hostel at the location of an existing structure is nonetheless included as H39.

Planning permissions for unbuilt residential properties were also researched for this area, with one 2021 replacement planning permission for the derelict house H16 granted under PA Reg. Ref. 21/51392. No other recent planning permissions have been found. H16, although currently derelict, is considered as an identified dwellinghouse.

Visualisations, including wireframes and photographs have been prepared from groups of these houses to represent the appearance of proposed wind turbines.

Assessment of impacts to visual amenity and the receiving landscape are addressed under Chapter 3 LVIA of this EIAR

Impact Assessment

There will be some effects from either of the two similar turbine modes assessed upon the visual amenity afforded from residences located within 10 rotor diameters of their nearest proposed turbine. The nature of the effects will vary depending upon the degree of screening afforded by vegetation and landform; the number and proportion of turbines visible; and the orientation of properties relative to the proposed development.

Theoretical views from sensitive residences are indicated in the 11 wireframes attached in the double-set figures: Figure 4-4-2-1 through to Figure 4-4-14-2. Each wireframe is in two sets (figure subsections -1 and -2), and on facing pages to represent the separate proposed turbine models options of N133 (Option 1) and E126 (Option 2).

The wireframes are of 180 degrees field of view and are portrayed from the relevant house and indicate the potential theoretical appearance of the proposed turbines without vegetation or structures. The wireframe views are taken from the actual house footprint. Technical data including location co-ordinates and distances to the nearest wind turbine proposed are also stated.

These wireframe figures also include photographs from public roads of the subject houses, noting that these are not photomontage visual representations.

There is little difference in visual dominance between either turbine model as is evident from these wireframe visualisations.

Assessment of the project's potential impacts to Residential Visual Amenity at each of these houses is made following, with theoretical wireframe visual representation Figures Housing Layout (HL) 03-11 prepared and included for dwelling houses in the A3 Figures attached.

Annex 4-2 provides a summary of the methodology and scope of work on visual residential amenity.

H24 is included although it is on the 10 times Rotor Diameter maximum N133 distance contour of 1,332m. It is noted that the front aspect of this house faces away from the proposed wind farm.

Buildings that may have previously been used as houses and are now derelict or ruinous, are not included in this residential amenity analysis. Derelict or ruinous buildings within the study area have been identified with House ID numbers H4 (no roof), H35 and H36.

As stated, the Draft Wind Energy Development Guidelines 20194 refer to a dwellinghouse to nearest turbine setback of X 4 times the maximum blade tip height. The maximum blade tip height of either of the two considered turbine models is 149.6m (N 133) X 4 = 598.4m. There are no habitable occupied houses within this rounded 600m distance at the Graffy wind park. The Draft document caveats that this setback requirement is also subject to the need to comply with the strict noise limits laid down in these Draft Guidelines. This is a specific planning policy requirement or SPPR of the Draft Guidelines, noting that they have not been as yet formally adopted.

Many of the houses within proximity to the proposed development are actually landowners. Some others are financially associated as indicated in Table 3 of Annex 4-2. These structures and dwellings identified within the X10 times RD distance are listed in the following Table 4-15 that summarises the visual effects significance on visual amenity resource change for the identified houses,.

Houses within the ten times maximum model blade diameter distance from the nearest wind turbine would have Minor to Moderate visual effects. This would be an acceptable level of significance impacts on residential visual amenity.

Table 4-15: Residential visual amenity effects at residences within 10 Rotor diameter distance from the proposed turbines.

Habitable Houses -19 no.	**Receptor sensitivity of dwelling houses**	**General Visual Resource Magnitude Change**	**Generalised Effect Significance**
H1	Medium	Negligible	Slight
H2	Medium	Medium	Moderate
H5	Medium	Medium	Moderate
H6	Medium	Medium	Moderate
H7	Medium	Medium	Moderate
H8	Medium	Negligible	Minor
H9	Medium	Medium	Moderate
H14	Medium	Medium	Moderate
H15	Medium	Medium	Moderate
H16	Medium	Medium	Moderate
H17	Medium	Medium	Moderate
H19	Medium	Negligible	Minor
H20	Medium	Negligible	Minor
H21	Medium	Negligible	Minor
H23	Medium	Negligible	Minor
H24	Medium	Negligible	Minor
H25	Medium	Negligible	Minor
H26	Medium	Negligible	Minor
H39	Medium	Negligible	Slight

The wind turbine models considered would present largely similar visual dominance with negligible differences in RVAA impacts between either turbine model.

Turbines which are located upslope, on higher ground from houses would not normally be visible at eye level, and only if a viewer were looking upwards.

Many houses have partial screening of views of the wind farm from intervening vegetation and land form. In the majority of cases, main house aspects and fenestration face away from the turbines.

The closest inhabited dwelling, H5 is located approximately 623m from the nearest proposed turbine location (T5) with a visual effect of Moderate. The house is: (a) more than 500m (the current recommended separation distance under the current Wind Farm Planning Guidelines 2006) from a wind turbine; (b) more than X4 times maximum model blade tip height of 598.4m from the nearest turbine; and (c) is associated with the wind farm as a landowner.

A planning permission for some 13 wind turbines on the site has just lapsed in early 2021 but they would still be considered as part of the receiving baseline environment and there would have already been visual dominance on proximate houses. The lesser turbine numbers, as reduced by 5 wind turbines will numerically reduce residential amenity impacts.

The 19 identified dwellinghouses within the maximum blade diameter distance of either turbine model considered would not experience any overwhelming/oppressive or overbearing effects on their visual outlook from either of the proposed turbine option models; with effects generally considered as largely Minor to Moderate with two houses having Slight impact.

These residential amenity effects are not considered unacceptable as the change in views would not render the identified dwellinghouses or sites as unattractive places to live, and therefore it is not considered that Residential Visual Amenity thresholds have been reached at these residential properties.

4.5.9. Cumulative impact

There are a number of other wind farm developments within 20 kilometres of the proposed development. These are as identified in the following Table 4-15. These include wind farm projects at Loughderryduff, Cullaigh, Anarget and Corkermore with the closest at 7.3km south with smaller turbines up to 55m hub height; and with the nearest other project beyond 15km. Table 4-16 refers.

The proposed turbines are to replace consented wind turbines within this landholding. There are no other additional turbines within the immediate area or within 7.3km, and which is well beyond the 10 times Rotor Diameter distance. There would be no significant additional cumulative residential visual overbearance impact with other wind energy developments at these dwellings.

Given the intervening upland topography there should not be significant cumulative residential visual effect on residences.

At these distances, of 7.3km and greater, the potential for significant cumulative impacts to population and human health with the proposed development are considered as limited.

The in-combination cumulative effects of other wind energy projects can have cumulative impacts on environmental aspects, particularly those such as: shadow flicker, noise and landscape and visual aspects. These cumulative impacts with wind energy projects in the wider area are addressed in the individual EIAR chapters.

Table 4-16: Proposed or existing turbines within 20km of the proposed Windfarm

Site	**Distance from proposed Windfarm Centre (m)**	**Turbine Type**	**Hub Height (m)**	**Planning Reference(s)**
Loughderryduff WF	15,845m	Vestas V52/850	64m	03/3043
Cullaigh WF	16,898m	Vestas V47	45m	97/1740
Anarget/Cronacarkfree WF, Inver	7,255m	Enercon E-44 (3) Vestas V47 (3)	c. 55m 45m	05/20375
Corkermore	17,482m	Gamesa G80	60m	01/846 07/20592

[illegible]				07/20250 09/20517

4.5 .10 "Do Nothing" Impact

If the optimised development were not to proceed, the previously permitted 13-turbine development would be constructed on site. Thus, the opportunity to install more efficient turbines, with two models assessed, to maximise the site's energy output, and to capture some of County Donegal's valuable renewable energy resource would be lost. So too would the opportunity to contribute to meeting Government and EU targets regarding increasing renewable energy production and reducing greenhouse gas emissions.

If the proposed wind farm and grid connection is not built there would be no resulting changes to the existing social and economic context. The local community, the region and the global environment would not benefit from this increase in green and renewable energy. The potential local income from this development to landowners, from council rates, the local community fund, jobs and business opportunities for construction companies, engineers, construction material providers and so forth, would not be created.

The proposal is likely to have both direct and indirect effects on the local and regional economy. It may be judged to be supportive of economic growth in the short and long term.

4.6. Avoidance, Remedial or Reductive Measures

4.6.1. Construction Phase

Employment and landowner income

The construction phase offers significant opportunities to the local region in terms of employment diversification and income generation, through supply of materials and services and through financial association with the development. Mitigation measures are thus not necessary for the associated potential positive impacts to employment opportunities that the development may bring.

Traffic

The construction phase of the proposed development will last for approximately 1 year, or 12 months. Turbines will be delivered to the proposed development site via the N56 from the port of Killybegs. From the N56, the turbine delivery route turns northwards onto the N15, before travelling westwards on the R252. The site will be accessed from this road. The proposed turbine delivery haul route is shown in preceding Figure 4-15.

A Traffic Management Plan will be developed by the selected contractor and agreed with Donegal County Council, to ensure any potential impacts to local roads, road users and traffic associated with the haulage of turbine components and construction materials, as well as the installation of the proposed cable, will be short term in duration and slight in significance. Local access to properties will be maintained throughout any construction works.

In terms of the construction of the underground grid-line, the area of work in any one day will be limited to approximately 150m in length. This will limit the extent and duration of any potential significant disruption. Such a plan will include measures to address conditions in specific sensitive locations and minimize the potential impacts related to the passage of heavy goods vehicles (HGVs) on public roads (including road damage, noise, and dust). Additionally, the machinery utilized during the wind farm and grid line construction phase will comply with national and international standards for health, safety and vehicle emissions, and will not operate outside of usual working hours. These measures will limit potential disturbance to the local residents. Details will be presented in an agreed Construction Environmental management Plan (CEMP).

Tourism

Given that there are no tourist attractions within the site itself, there is no potential for direct negative impacts on tourism predicted during the wind farm and grid connection construction phase.

Some traffic restrictions will be in operation during the wind farm and grid connection construction phase, which may result in slight short-term, negative impact on tourism. However, such negative impacts will be time limited and non-permanent. See preceding paragraph for further details on proposed traffic related mitigation measures. .

Noise

The construction phase will see an increase in noise levels in the area due to the nature of construction work and the heavy machinery used, however such impacts will be short-term in duration. The noisiest activities associated with wind farm construction are soil and rock excavation and transport, as well as the pouring of concrete for the turbine bases. Excavation of each base can usually be completed in one or two days, whilst the concrete pour can be completed in a matter of hours; note that the latter is typically completed in one continuous pour.

The level of construction noise experienced at any given noise sensitive location will vary throughout the construction phase, as the activities being undertaken will vary from week to week. The receiving properties are also located at varying distances from the construction site so will experience different noise levels. The potential noise impacts of the construction phase are further detailed in Chapter 5 of this EIAR and have been determined to be within the limits of acceptability.

Best practice measures will be followed during the construction phase of the proposed development to mitigate the identified slight short-term negative impacts. Measures include ensuring machinery is shut off or throttled back to a minimum when not in use; limiting hours of activity to avoid construction during unsociable hours; and fitting all vehicles and mechanical plants with exhaust silencers.

Residential visual amenity

The construction stage when wind turbines are erected can produce moderate change to the residential visual resource of householders. Given that their construction and assembly is of temporary duration the construction stage effects on residential visual amenity are not considered significant.

Air quality (Dust)

During the construction phase, dust emissions may come from sources including the creation of new roads and turbine foundations as well as existing access tracks. Dust from the construction site may be transferred to the public road by the construction vehicles as they enter and exit the site; this matter may turn into mud, particularly if the weather is wet, and become a nuisance to road users. To mitigate this, any areas of excavation will be kept to a minimum, and stockpiling will be reduced by coordinating excavation, spoil storage and landscaping works. Construction vehicles will be limited to a defined route and will adhere to a speed limit.

Dust suppression may become necessary during any extended periods of dry weather, in order to prevent the dust from becoming a nuisance. To combat this, water from the site's drainage system will be pumped into a bowser or water spreader and used to dampen the haul roads and prevent the creation of dust. It is important to note that silty or oily water will not be used in this mitigation effort as to do so would cause pollutants to be transferred to the haul roads, and potentially migrate to watercourses polluted runoff.

As the proposed grid connection route is constructed, the active construction area will be small - approximately 150m in length at any given time. If multiple crews are working on the line simultaneously, these will be separated by one or two kilometres. Machinery used during the construction will be maintained in good operational order while on-site, in an effort to minimise any likely emissions. Similarly, materials needed for the creation of the cabling route will be sourced locally in order to reduce vehicle movement and in turn the volume of emissions associated with this activity. Overall, potential dust emissions during the construction phase will not be significant and will be relatively short-term in duration, and are not considered significant.

Health and Safety

The developer will establish a safety management system encompassing risk assessment, design measures and management instructions to ensure the safety of construction and operation staff and the public.

The machinery used during the construction of the proposed development poses a potential health and safety hazard to construction workers if site rules are not properly implemented and followed. This will have a short-term potential significant negative impact.

During the construction phase of the proposed development and linked grid connection, all staff and personnel will be made aware of, and instructed to adhere to the Health & Safety Authority's '*Guidelines on the Procurement, Design and Management Requirements of the Safety, Health and Welfare at Work (Construction) Regulations 2006*'. Adhering to these guidelines will mean that onsite staff and visitors will have to use Personal Protective

Equipment and comply with the site Health and Safety Plan. The plan will address health and safety risks through the following arrangements:

- Unauthorised entry to the wind farm site will be controlled by the installation of gates and trained personnel to meet vehicles at the point(s) of site entry.
- Site entrants will be required to undergo site safety induction before entry to the works area.
- Fencing will be installed in areas where uncontrolled access is not safe or permitted
- Health and safety signage and instructions will be installed along the public road on the approach to the site entrance and grid installation works, at the site entrance and around the wind farm and grid installation works areas, including at the site compound and within contractor's welfare facilities.

There are no significant negative impacts predicted to arise during the construction phase; health and safety guidelines will be strictly adhered to and will act as mitigation measures for any issues that could be associated with the construction, operation and decommissioning phases.

Following the application of appropriate measures to protect safety and health risks to public safety during construction will be of negligible significance.

Land contamination

In relation to land quality and contamination, there is no evidence or historic knowledge of activities, or current contamination concerns that would give rise to land contamination of risk to health on the site.

4.6.2. Operational Phase

The effects explored below relate to the operational phase of the proposed wind farm. All works for the grid connection project will be completed during the construction phase, so there are no further potential impacts to population and human health associated with the grid connection project during the operational phase.

Employment

Mechanical-electrical contractors have the opportunity to become involved with the maintenance and operation of the wind farm during the operational phase of development.

Financial

As outlined previously, there are significant and positive financial benefits associated with the operation of the proposed development these include

- Annual contribution to community fund,
- Annual rates payment,
- Rural Diversification,
- Landowner income.

Traffic

As the windfarm moves out of the construction phase, the number of vehicles travelling to and from the site will decrease significantly. Monthly maintenance checks will mean that a small number of vehicles will be visiting the site, but HGVs will be only be necessary if there is a need for repair or maintenance action, and will thus visit the site infrequently.

Tourism

Survey work from the DoEHLG's Wind Energy Development Guidelines for Planning Authorities 2006 found that wind energy and tourism can "*co-exist happily*". As such, the proposed development is not expected to negatively affect tourism in the wider area. On the contrary, there is potential for Graffy wind farm to actually act as a visitor attraction in itself. As previously mentioned, wind farms in other parts of the world have been found to attract tourists - for example, consider how Britain's first wind farm in Delabole, Cornwall, receives over 350,000 visitors annually.

Noise

A Noise Impact Assessment has been carried out by Irwin Carr Consulting in accordance with the relevant methodology, and detailed results are provided in Chapter 5 of this EIAR. No significant operational adverse noise impacts are predicted.

Shadow Flicker

Canavan Associates have prepared a Shadow Flicker assessment of the proposed Graffy wind farm development and the two proposed turbine model options, on local residences and sensitive receptors. This assessment has indicated that a single (financially associated) property may experience shadow flicker *in excess* of the current DoEHLG guideline threshold of 30 minutes per day or 3 hours per year, as a result of the Graffy Wind Farm. Shadow flicker modelling is removed from real world experience and requires the occurrence of a number of environmental factors at once. Various mitigation measures can be employed to reduce the shadow flicker in the affected property if indeed this is experienced. Such measures include the installation of window blinds or curtains in affected rooms, planting of screening vegetation or the installation of a shadow flicker shutdown module into each turbine, which will turn the relevant turbine off during conditions conducive to the occurrence of Shadow flicker. This will eradicate the experience at shadow flicker at nearby sensitive receptors. Further details are outlined in the annexed Shadow Flicker report.

Residential Visual Amenity

Existing intervening topography and partial screening of views of turbines from affected house aspects reduces visual overbearance. There are little effective mitigation measures such as landscape planting or screening around house curtilages that would further alleviate residential amenity overbearing. Turbines will however be turning in the same direction and all 8 proposed turbines will be of the same turbine model.

Air and Climate

The proposed development will result in the avoidance of air pollution and generation of greenhouse gases by renewable energy generation of up to 35.88 MW from the power of the wind, as opposed to resulting from fossil fuel combustion.

The proposed development will make a notable contribution to national and international renewable energy and emissions reduction targets. More details and discussion of these significant positive impacts are outlined in the Air and Climate chapter of this EIAR.

Health and Safety

There are few health and safety threats created by the operation of the proposed Graffy wind farm; indeed the DoEHLG's '*Wind Energy Development Guidelines for Planning Authorities 2006*' support this by noting there are no specific safety considerations pertaining to the operation of turbines. It is not necessary to surround the turbine with fencing, as people and animal can safely walk up the base of these structures.

The DoEHLG Guidelines do state that there is a small possibility of people being struck by ice or damaged blade sections falling from the turbine. However, this risk is unlikely and has been minimised, as described in the preceding sections.

4.6.3. Decommissioning Phase

The wind turbines of the proposed development are expected to be in place for 25 years from the date of commissioning. Following completion of the operational lifetime of the proposed Graffy wind farm, and in the absence of any further planning permission for continued operation, project decommissioning will entail project de-energization and removal of the turbine components and all above ground development from the site and unused elements can be grassed over.

It is recommended that the proposed access tracks and underground electrical cables be retained at the site, since their removal would cause habitat and ecological disturbance.

All aspects of reinstating the site will be carried out in accordance with a decommissioning plan and with the same care and attention to detail as the construction phase.

The decommissioning phase of the Graffy Wind Energy and Grid Connection Project will not pose any significant negative impacts, assuming that the decommissioning works are all completed in line with the necessary national and international health and safety regulations.

4.7. Residual Impacts

4.7.1. Social and Economic Benefits

Economic benefits will include:

- Direct landowner payments;
- Contribution of an annual sum to a local Community Benefit fund;
- Substantial annual rates payments;

- Direct and indirect employment opportunities for local people during the construction phase of the development;
- A number of employment opportunities during the operation of the wind farm;
- Opportunities for local businesses to supply goods, services, and accommodation during the construction period;
- Opportunity for local industries to diversify into, or gain experience in, installation, operation and maintenance of wind energy, grid line and related electrical technologies;

The social and environmental benefits of renewable wind energy are likely to be less tangible but may be most evident in settlements such as those present at the site, as these are remote, rural, small populations. Social benefits may include:

- Opportunity for education and increased awareness of renewable energy and environmental issues and responsibility;
- Mitigation of the effects of climate change – contribution to national targets and to improved long term health and quality of life.

Environmental, Community, employment and financial impacts in this local area, and in the wider region are all significantly positive, as outlined.

4.7.2. Access and Traffic

In terms of potential impacts, access to the proposed development site may be restricted during the construction period. Access to the site will likely be easier during the operation of the wind farm due to the presence of upgraded tracks between the site entrance and the turbine positions however the wind farm is located on private lands and access will be for the land owner, land managers and authorised personnel only.

While there will be construction traffic on the public roads approaching the proposed wind farm site, as well as along the route of the proposed underground grid connection, there will not be a significant negative impact, so long as the traffic is managed successfully. There will only be a slight adverse impact which may affect the material of the roads themselves, nearby residents and road users. These effects will be subject to repair ad reinstatement and will thus be temporary in nature associated with the 12 month construction phase.

During the operational phase of the wind farm, the potential for traffic generation will be minimal.

4.7.3. Tourism

As indicated in the previous sections of this report, opinion polls have found that the presence of a wind farm would not necessarily dissuade respondents from visiting an area for reasons of tourism. Indeed, many have noted that the presence of a wind farm would increase their desire to visit the area. The proposed development is not predicted to have significant adverse impact on local tourism or tourism facilities.

4.7.4. Noise

Noise impacts have been assessed in association with wind farm and grid connection construction and operation. These are not considered to be significant.

4.7.5 Shadow Flicker

The shadow flicker assessment found that some level of shadow flicker is predicted to occur at a number of properties in the vicinity of the site as a result of the operation of the turbines. Mitigation measures, as previously outlined, will eradicate the occurrence of this impact if necessary. The grid line element of this proposal holds no potential to contribute to the shadow flicker impacts.

4.7.6. Air Quality and Climate

The proposed renewable energy development will avoid the generation of air pollution and Greenhouse Gases, which would otherwise have been released if this same energy had been produced through the combustion of fossil fuels. The development will also make a notable contribution to national and international renewable energy and emissions reduction targets. This is a significant and positive impact which requires no mitigation.

4.7.7 Residential Visual Amenity

Mitigation measures are not proposed with operational visual amenity effects unchanged

4.7.8. Health and Safety

Health and safety measures for the proposed Graffy Wind Energy and Grid Connection Project will comply with any and all relevant legislation. A health and safety plan will be prepared for the development in advance of works commencing, and will cover both the construction and operation of the wind farm and associated underground grid connection.

4.7.9. Ancillary development

The grid connection will be underground thus there will be no visual effect once installed.

The substation is east of the ruin that is H4. This is sited on a relatively low lying area and partially screened by small knolls to the south and east, with no direct line of sight from H5, the closest house to the substation site.

The lattice anemometer mast close to T8 will be at least 500m from the nearest dwelling. With no significant adverse visual impact anticipated from dwellinghouses from this slim and static structure, which will replace the existing on-site met mast in this position.

The undergrounded power line will connect to the Eirgrid substation at Tievebrack over 4.5 km west of T8.

During construction stage there will be visual disturbance from construction machinery visible largely along the local road network from residences.

No significant adverse residential visual overbearance impact is predicted from ancillary wind farm developments of the proposal.

4.8. Summary of Impacts and Conclusion

A summary of impacts during the construction, operational and decommissioning phases of the proposed development, and their significance is provided in the Table which follows.

Table 4-17: Summary of Residual Impacts on population and human health and assessment of impact significance

Impact	Nature of residual impact	Significance Rating after Mitigation
CONSTRUCTION PHASE (approx. 12 months)		
Employment	Direct and indirect employment opportunities for local people during the construction phase of the development	Significant positive
Traffic	Transportation of construction materials and turbine components (abnormal loads) along local roads to the Wind Farm site. Installation of underground cable in local public roads.	Slight adverse
Tourism	Delays and disruption on local roads. Impact on local tourism facilities and amenities. Visual impact and impact on Landscape.	Slight adverse
Noise	Noise from construction vehicles and onsite works, transportation of materials	Negligible
Air quality and climate	Generation of dust from construction works	Negligible
Health and Safety	Risks to health and safety from construction works	Negligible
OPERATIONAL PHASE (25 years)		
Employment	Minimal operational phase employment opportunities	Negligible

Financial	Annual contribution to community fund. Annual rates payment, Rural Diversification, Landowner income	Significant positive
Access & Traffic	Minimal operational phase traffic	Negligible
Tourism	Impact on local tourism facilities and amenities. Visual impact and impact on Landscape.	Slight adverse
Noise	Operational noise from turbines.	None
Shadow Flicker	Shadow flicker effect from operational turbines	Negligible
Residential visual amenity	Visual overbearance on visual amenities of dwelling houses and curtilages within ten rotor diameters of a turbine	Minor /Moderate
Air quality and Climate; Carbon footprint	Avoidance of air pollution and generation of greenhouse gases by renewable energy generation as opposed to fossil fuel combustion. Contribution to National and international renewable energy and emissions reduction targets.	Significant Positive
Health and Safety	Risks to health and safety from operation of wind farm and underground transmission of electricity	Negligible
DECOMMISSIONING PHASE		
Employment	Direct and indirect employment opportunities for local people during the decommissioning phase of the development	Slight positive
Traffic	Transportation of waste and recycling materials and turbine components (abnormal loads) along local roads. Deactivation of underground cable in local public roads.	Slight adverse

Noise	Noise from vehicles and onsite works, transportation of materials	Negligible
Tourism	Delays and disruption on local roads.	Negligible
Air quality and Climate	Generation of dust from decommissioning works	Negligible

The residual construction and operational stages effects on population and human health of the proposed development, following the implication of the proposed mitigation measures, as applicable to both wind turbine model options, will not result in any unacceptable significant effects on population or human health in the relevant study areas.

5. NOISE

IRWIN CARR
CONSULTING

NOISE ASSESSMENT
GRAFFY WIND FARM

Rp0010 2019162 (Graffy Wind Farm)
16 September 2021

PROJECT:	GRAFFY WF
PREPARED FOR:	CUILFEACH TEORANTA FIRST FLOOR MC KENDRICK PLACE PEARSE ROAD LETTERKENNY CO. DONEGAL
ATTENTION:	CUILFEACH TEORANTA
REPORT NO.:	Rp 0010 2019162

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Document Control

Status:	Rev:	Comments	Date:	Author:	Reviewer:
Final	1.0		16 Sep 2021	Liam McAleavey	Shane Carr
				Liam McAleavey	Shane Carr

Contents

5.0 Noise

5.1 INTRODUCTION

Irwin Carr Ltd have been commissioned by Cuilfeach Teoranta Ltd to assess the noise impact from a proposed wind farm near Glenties, Co. Donegal, and associated grid and haul proposals. The proposed wind farm will comprise of eight turbines with a hub height of 83/86m and a blade tip height of 149.5/149m.

It is understood that this report will be submitted for assessment by Donegal County Council, as part of a comprehensive Environmental Impact Assessment Report.

Acoustic terminology used throughout this report is described in Appendix A.

5.2 ASSESSMENT CRITERIA

Guidance in relation to wind turbine noise is the Wind Energy Development Guidelines 2006. This guidance has been succeeded by a draft guidelines document released in December 2019. This document has adopted many components from ETSU-R-97 – *The Assessment and Rating of Noise from Wind Farms*. For the purposes of this report, results have primarily been assessed in line with the draft guidelines, with reference to appropriate aspects of ETSU-R-97.

5.3 Draft Wind Energy Development Guidelines

Current guidance in relation to wind turbine noise is the Wind Energy Development Guidelines 2006.

WIND ENERGY DEVELOPMENT GUIDELINES 2006

The Wind Energy Development Guidelines 2006 (WEDG06) were drawn up under the direction of the Department of the Environment, Heritage and Local Government with the aim of providing advice to planning authorities, developers and the wider public regarding the environmental assessment of noise from wind turbines.

The WEDG06 document lays down the requirements for wind turbine proposals to offer a protection to properties located within proximity to the proposed wind development.

The document recommends that separate noise limits apply for daytime and night-time with the emphasis on the protection of external amenity during the daytime and the prevention of sleep disturbance during the night-time.

The noise limits are as follows:

- 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.
- A fixed limit of 43dB(A) will protect sleep inside properties during the night

WIND ENERGY DEVELOP MENT GUIDELINES 2019

The new draft Wind Energy Development Guidelines (WEDG19) dated December 2019 are an update of the previous 2006 guidance, and impose more stringent regulations, in line with ETSU-R-97 – *The Assessment and Rating of Noise from Wind Farms*.

This guidance has adopted the approach of establishing a Relative Rated Noise Limit (RRNL) from ETSU-R-97. The RRNL is determined through background monitoring before the wind energy development is in operation.

The relative rated noise level resulting from the wind energy development and taking into account the cumulative impact of noise levels resulting from the other existing and approved wind energy developments shall not exceed:

- Background noise levels by more than 5 dB(A) within the range 35-43 dB(A), or
- 43 dB(A).

The WEDG19 document lays down the requirements for wind turbine proposals to offer a protection to properties located within proximity to the proposed wind development and effectively produces three separate limit levels depending on the time of the day:

- Night-time (23:00-07:00) limit is background +5dB within the 35-43dB range
- Evening (19:00-23:00) limit is an additional 5dB on night-time within the 35-43dB range
- Daytime (07:00-19:00) limit is 10dB on top of night-time within the 35-43dB range

Where a property is financially involved, the noise limit can be set at 43dB for all periods and wind speeds.

5.4 ETSU-R-97

The Institute of Acoustics published a 'Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (IOA, 2013). This good practice guide lays out information on how to competently carry out procedures relating to the assessment of wind turbine noise.

The WEDG19 adopt the approach set out in this guidance, along with international standards and guidance on tonal noise and low frequency noise for wind energy developments in Ireland.

5.5 METHODOLOGY

5.6 Noise Prediction Methodology

Operational wind turbine noise levels were predicted for all residential dwellings considered within this assessment using a three-dimensional computer noise model generated in *SoundPLAN.*

The model was implemented in *SoundPLAN* version 8.2, which is produced by Braunstein & Berndt GmbH. The *SoundPLAN* implementation of ISO9613-2:1996 has been tested in-house by *SoundPLAN* developers to ensure calculated results are within 0.2dB of the standard.

Appendix B provides details of the implementation of ISO9613-2:1996 within the *SoundPLAN* modelling software.

5.7 Air Absorption

Spectral content of the wind turbine noise emissions can be important as different wind turbine models emit noise with different amounts of low and high frequency content. Low frequency sound attenuates at a relatively slow rate in air. For this reason, octave band sound power levels together with the appropriate air absorption coefficient for each octave band in accordance with ISO9613-1:1993 have been used to predict noise emissions from the selected wind turbines more accurately. The octave band absorption coefficients used are presented in Table 1.

Table 1: ISO 9613-1:1993 air absorp tioncoefficients

Description	Octave band mid frequency								
	63	125	250	500	1k	2k	4k	8k	Hz
Air absorption coeffi cient	0.12	0.41	1.04	1.92	3.66	9.70	33.06	118.4	dB/km

The following data has been used in the calculation of the air absorption coefficient.

- air temperature: 10°C
- air humidity: 70%
- air pressure: 1,013.25mbar

5.8 Sound Power Levels

The turbines used for this assessment are the Enercon E-126 EP3 4MW and Nordex N133 4.8MW. Sound power data used to predict noise impact of the wind turbines has been taken from the manufacturer datasheet – 'ENERCON Wind Energy Converter E-126 EP3 / 4000 kW with TES (Trailing Edge Serrations)' dated 29 April 2019 and Nordex Noise level, power curves, thrust curves – Nordex N133 dated 20 October 2020.

The information provided shows the rate of increase in the noise level with increasing wind speed. The sound power levels for the E-126 used include uncertainty, as described in section 2 *(Sound power level)* of the aforementioned document. The Nordex N133 turbines include a +2dB uncertainty factor. The noise levels shown in Figures 1 and 2 below takes account of the increase in noise levels and shows the octave-band data for the 9m/s wind speed (rated power).

The above identified measurement margins of error have been incorporated into the noise levels shown in Figures 1 and 2 below. Therefore, the levels below were used within the noise modelling.

Figure 1: Sound power level profile referenced to wind speeds 10m AGL – Enercon E-126 and Nordex N133

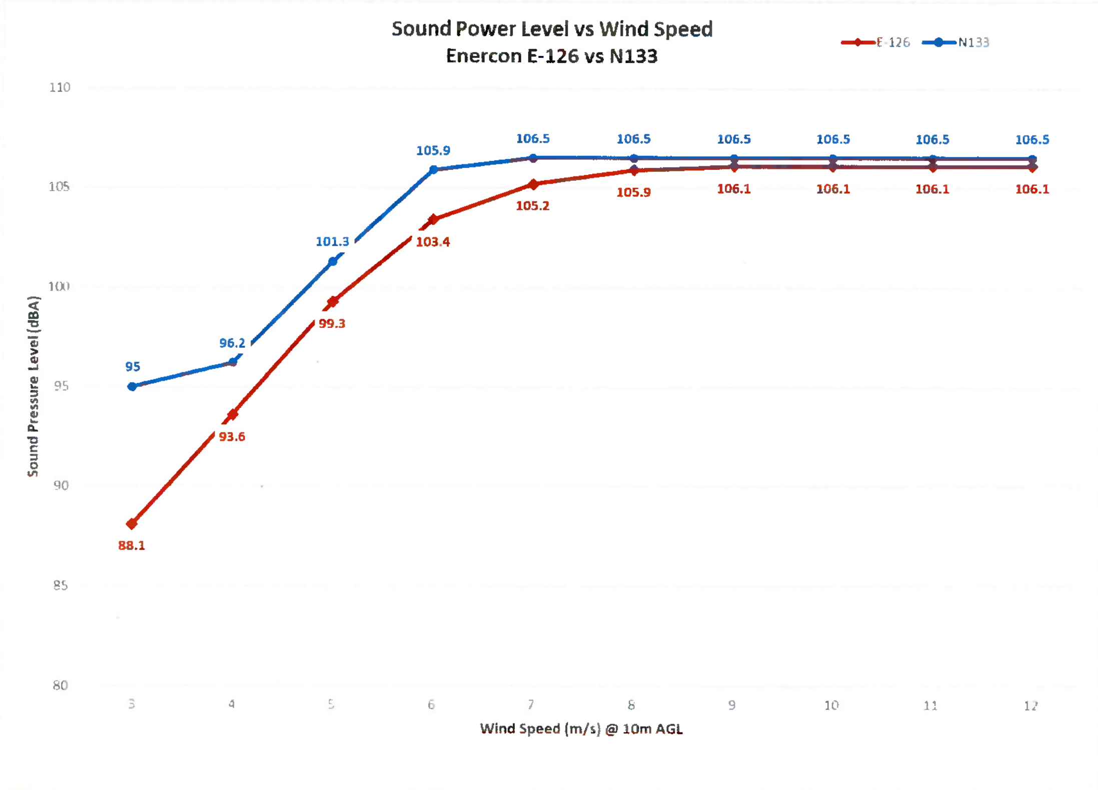
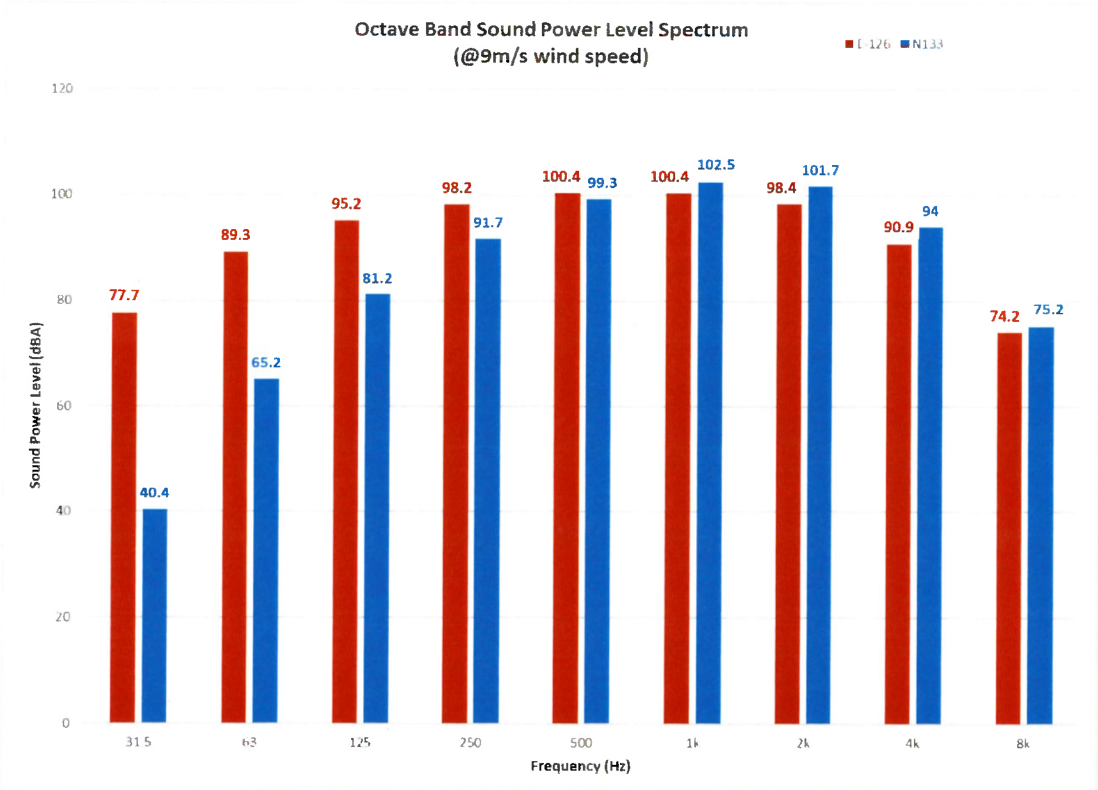


Figure 2: Wind turbine frequency spectrum – Enercon E-126 and Nordex N133



The reference octave band sound power spectrum of the wind turbines are presented in Figure 2. The reference frequency spectrum provided relates to 9m/s wind speed (rated power) @ 10m AGL, as provided in the general specification. This noise level within each octave band was increased by the appropriate margin of error. This frequency data template was used to generate noise levels at each wind speed as shown in Figure 1 above.

5.9 BACKGROUND NOISE MONITORING

Background noise monitoring was carried out at a location in the vicinity of the site over a period of 15 days, as per the requirements of ETSU-R-97.

Simultaneous wind speed monitoring was undertaken at hub height. Rainfall monitoring was also carried out at the noise monitoring location for the duration of the survey. Where any periods of rainfall were identified, the associated noise and wind speed data points were removed from the regression analysis.

Baseline monitoring was carried out between Wednesday 25 September 2019 and Wednesday 9 October 2019. The noise monitoring location is described in Table 2 below and can be seen in Appendix C.

Table 2: Noise Monitoring Location

Noise Monitoring Location	Grid Reference
NML	191345 397854

The noise monitoring equipment used during the survey was:

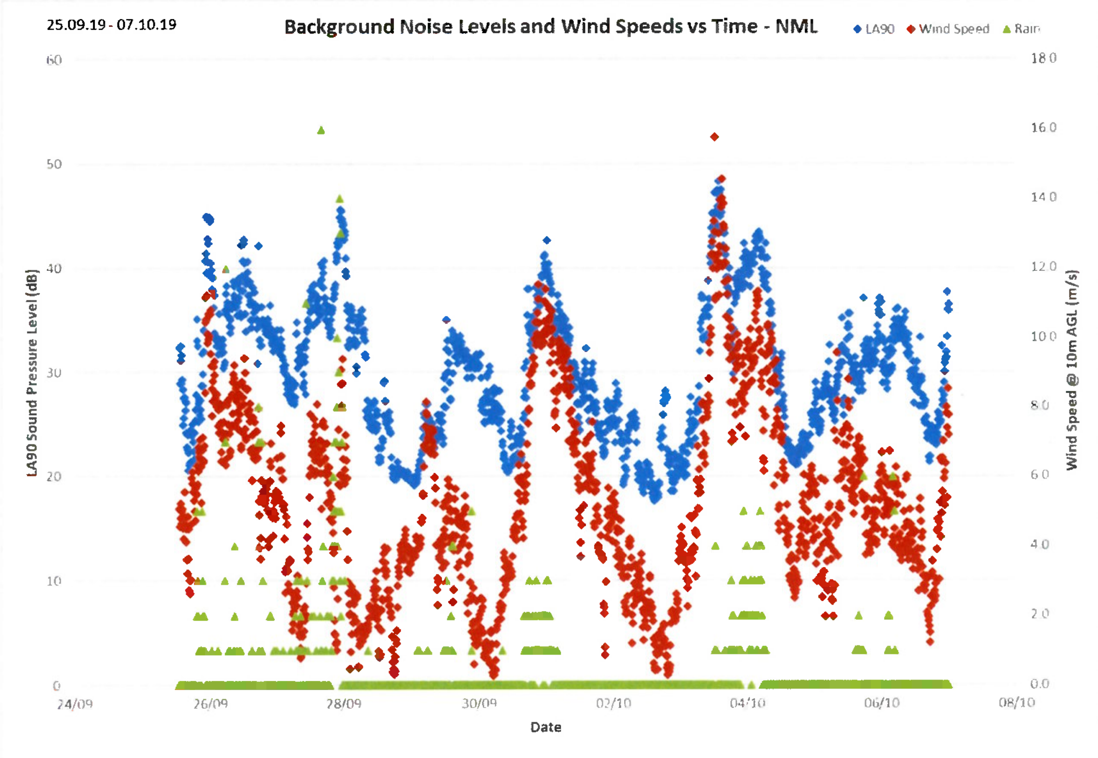
- 2 x Larson Davis LxT Sound Level Meter with environmental protection kit including a large 30ppi foam windscreen which complies with the ETSU W/13/00386/REP
- 2no. onset HOBO data logging rain gauge

The sound level meter has been calibrated within the 24 months of the survey date. The measurement microphone was located at least 1.2m above ground height and at least 3.5m from any building facade. The measurement location was selected to minimise the effects of reflections from buildings and are representative of the existing background noise levels in the vicinity of the proposed windfarm.

The Sound Level Meter was set to record L_{A90} over synchronised ten-minute intervals to the rain gauge and anemometer, as specified in ETSU-R-97.

Figure 3 below shows the correlation between the measured wind speed and noise level at the noise monitoring location, including periods of rainfall. The background noise and wind speed vs. time for the monitoring period indicated a good correlation between the measured noise level data and the wind speed data.

Figure 3: Background noise and wind vs. time at Noise Monitoring Location



5.10 Wind Speed

In order to establish the existing background sound pressure level across all operational wind speeds, wind speeds were measured throughout the background noise survey using a met mast close to the proposed location of turbines

The mast captured wind speeds representative of the proposed 83/86m hub height, logged for the duration of the survey over 10-minute averaging time periods, then standardised down to 10m height using the equation below:

$$V_{10std} = V_{hh} [L_n(H_{10}/z_0) / Ln(H_{hh}/z_0)] \qquad [1]$$

Where:

V_{10std} = derived wind speed at height 10m in m/s

V_{hh} = wind speed at hub height in m/s

H_{10} = 10m

H_{hh} = hub height (83/86m)

Z_0 = the surface roughness length (m).

A reference roughness factor of 0.05m is used to calculate wind speeds in accordance with IEC 61400-11.

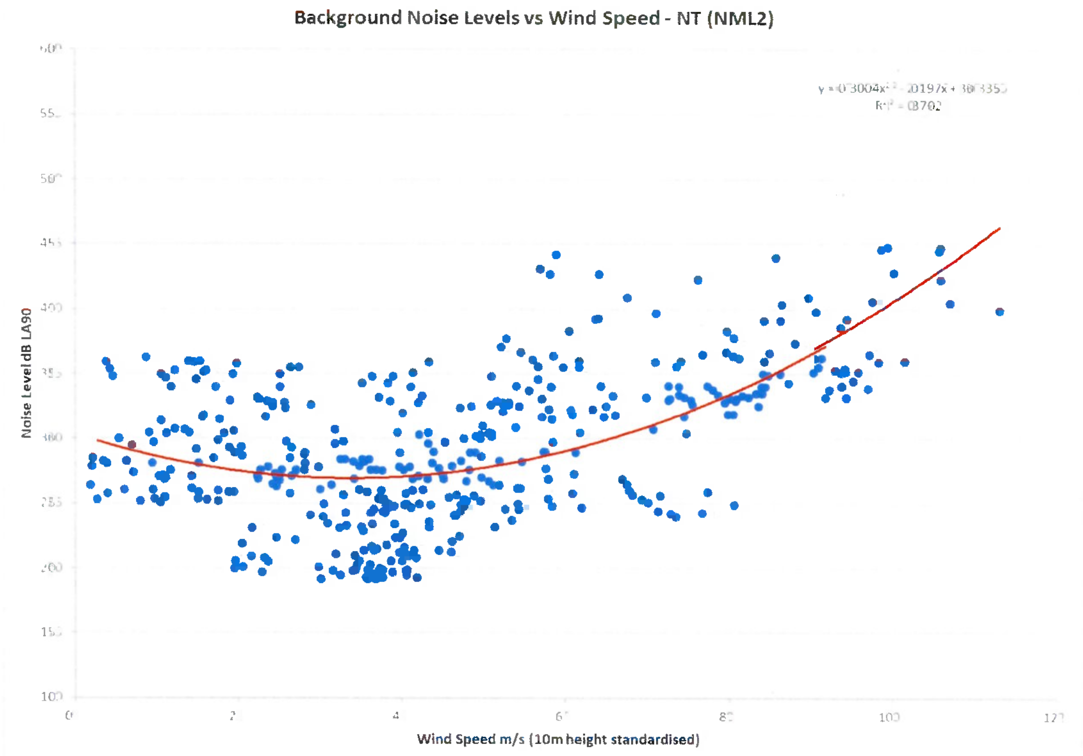
The derived wind speeds were calculated using equation [1], for each ten-minute period, with the derived values compared to the background noise levels as per ETSU-R-97.

5.11 Noise Monitoring Results

The L_{A90} values where rainfall was recorded, as required in ETSU-R-97, were omitted from any part of this assessment process.

For the noise monitoring location, wind speed and recorded $L_{A90,10}$ min during quiet daytime were plotted on a scatter graph with polynomial best fit line applied. This was also repeated for the night-time period. These wind speed and noise levels recorded correspond with times over the survey period where rainfall was not recorded. These graphs are shown below as Figure 4.

Figure 4: Night-time – NML



From the polynomial best fit line, the average L_{A90} sound pressure level were derived for the wind speeds between 4m/s and 12m/s during the quiet daytime and night time at each monitoring location. The results are shown in Table 3 below with the limit values of also shown:

Table 3: Average L_{A90} noise levels with background +5dB limit at Noise Monitoring Location

Wind Speed (m/s)	Quiet Daytime		Night-time	
	Bkg L_{A90}	WEDG Limit	Bkg L_{A90}	WEDG Limit
4	28.5	43	38.5	35
5	29.8	43	39.8	35
6	27.8	42.8	37.8	35
7	28.4	43	38.4	35
8	35.4	43	43	40.4
9	35.8	43	43	40.8
10	38.1	43	43	43
11	39.5	43	43	43
12	39.5	43	43	43

5.12 NOISE PREDICTIONS

Noise emissions from the proposed Windfarm site at the residential properties in the closest proximity to the site have been assessed. The 30 closest residential properties are within 2.5km and described in Table 4: below, and shown in the layout in Appendix D.

Table 4: Source and Receiver co-ordinates

Location	Irish National Grid (ING) Co-ordinates		Distance to Nearest Turbine (m)	Nearest Turbine
	X	Y		
Wind Turbine Location (T1) –	191738	398370	-	-
Wind Turbine Location (T2) –	190860	398240	-	-
Wind Turbine Location (T3) –	190657	397779	-	-
Wind Turbine Location (T4) –	190583	397297	-	-
Wind Turbine Location (T5) –	190210	397043	-	-
Wind Turbine Location (T6) –	190160	397408	-	-
Wind Turbine Location (T7) –	189747	396594	-	-
Wind Turbine Location (T8) –	189604	396205	-	-
H2 (FI)	191350	397840	630	1
H3	**190172**	**396632**	413	5
H4	**190007**	**396566**	261	7
H5 (FI)	190466	396475	623	5
H6 (FI)	190726	396537	723	5
H7 (FI)	190713	396379	833	5
H8 (FI)	190732	395978	1150	8
H9 (FI)	190971	396037	1261	5
H11	191363	396178	1364	4
H12	191863	396346	1595	4

Location	Irish National Grid (ING) Co-ordinates X	Irish National Grid (ING) Co-ordinates Y	Distance to Nearest Turbine (m)	Nearest Turbine
H14	190322	395713	870	8
H15 (FI)	190272	395680	849	8
H16	190204	395630	831	8
H17	189825	395492	747	8
H18	**189640**	**395965**	243	8
H19	188842	396403	788	8
H20	188860	396428	777	8
H21	188848	396494	810	8
H22	**188678**	**396526**	**981**	**8**
H23	188574	396588	1099	8
H24	188351	396641	1327	8
H25	188345	396267	1261	8
H26	188318	396266	1288	8
H27	188005	396492	1625	8
H28	187850	396520	1783	8
H29	187804	396458	1818	8
H30	187671	396399	1943	8
H31	187374	396240	2231	8
H32	188211	395451	1585	8
H33	188185	395311	1678	8
H34	187997	395434	1783	8

There are four properties in the vicinity of the site which are derelict (H3, H4, H18 and H22). They are highlighted in Table 4, but have not been considered as residential receptors in the rest of this report, as they are not habitable properties.

Property H31 has not been assessed as it is located more than 2km from the nearest turbine – further than all other receptors. It is anticipated that the wind farm will have less impact on this receptor in comparison to closer receptors.

The height of the noise receptor was set at 4m to represent an upstairs bedroom window, deemed appropriate as WEDG19 specifically addresses the concerns of potential noise disturbance during the night.

The *SoundPLAN* noise model predicts the noise level as L_{Aeq} dB values. ETSU-R-97 guidance advises that the L_{Aeq} values are likely to be in the region of 1.5-2.5dB above the

L_{A90} levels, therefore a 2dB reduction have been made from the L_{Aeq} levels to covert to L_{A90}.

5.13 Results – Enercon E-126 (with Serrated Trailing Edge)

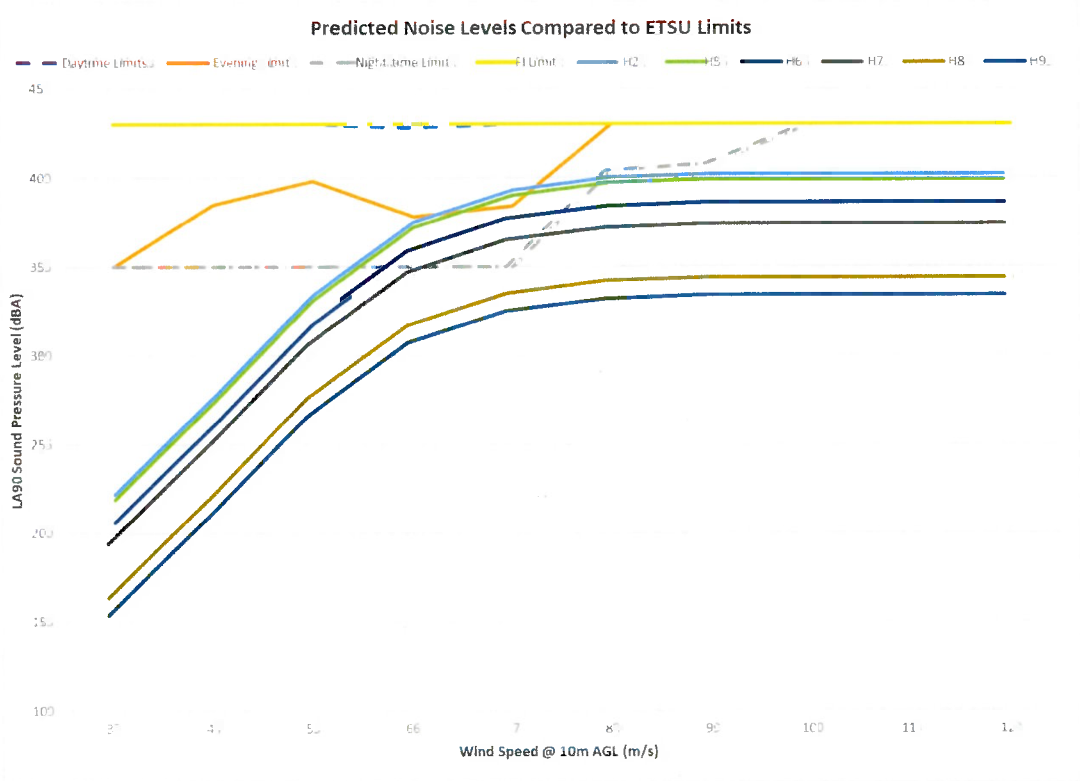
The predicted noise levels as a result of the operation of the proposed Windfarm comprising of eight Enercon E-126 turbines are provided in Table 5 and Figure 5 below, with a noise map provided in Appendix E showing the noise contours. The results have been compared to WEDG limits.

Table 5: Predicted L_{A90} Noise Levels Compared to WEDG Limits

Wind Speed, m/s	Predicted L_{A90} Noise Level (dB)									
	3	4	5	6	7	8	9	10	11	12
Daytime Limit	**43**	**43**	**43**	**42.8**	**43**	**43**	**43**	**43**	**43**	**43**
Evening Limit	**35**	**38.5**	**39.8**	**37.8**	**38.4**	**43**	**43**	**43**	**43**	**43**
NT Limit	**35**	**35**	**35**	**35**	**35**	**40.4**	**40.8**	**43**	**43**	**43**
H2 (FI)	22.2	27.7	33.4	37.5	39.3	40	40.2	40.2	40.2	40.2
H5 (FI)	21.9	27.4	33.1	37.2	39	39.7	39.9	39.9	39.9	39.9
H6 (FI)	20.6	26.1	31.8	35.9	37.7	38.4	38.6	38.6	38.6	38.6
H7 (FI)	19.4	24.9	30.6	34.7	36.5	37.2	37.4	37.4	37.4	37.4
H8 (FI)	16.4	21.9	27.6	31.7	33.5	34.2	34.4	34.4	34.4	34.4
H9 (FI)	15.4	20.9	26.6	30.7	32.5	33.2	33.4	33.4	33.4	33.4
H11	14.1	19.6	25.3	29.4	31.2	31.9	32.1	32.1	32.1	32.1
H12	12.1	17.6	23.3	27.4	29.2	29.9	30.1	30.1	30.1	30.1
H14	17	22.5	28.2	32.3	34.1	34.8	35	35	35	35
H15	17	22.5	28.2	32.3	34.1	34.8	35	35	35	35
H16	17	22.5	28.2	32.3	34.1	34.8	35	35	35	35
H17	17.2	22.7	28.4	32.5	34.3	35	35.2	35.2	35.2	35.2
H19	17.6	23.1	28.8	32.9	34.7	35.4	35.6	35.6	35.6	35.6

Wind Speed, m/s	Predicted LA90 Noise Level (dB)									
	3	4	5	6	7	8	9	10	11	12
Daytime Limit	**43**	**43**	**43**	**42.8**	**43**	**43**	**43**	**43**	**43**	**43**
Evening Limit	**35**	**38.5**	**39.8**	**37.8**	**38.4**	**43**	**43**	**43**	**43**	**43**
NT Limit	**35**	**35**	**35**	**35**	**35**	**40.4**	**40.8**	**43**	**43**	**43**
H20	17.8	23.3	29	33.1	34.9	35.6	35.8	35.8	35.8	35.8
H21	17.6	23.1	28.8	32.9	34.7	35.4	35.6	35.6	35.6	35.6
H23	14.7	20.2	25.9	30	31.8	32.5	32.7	32.7	32.7	32.7
H24	12.7	18.2	23.9	28	29.8	30.5	30.7	30.7	30.7	30.7
H25	12.5	18	23.7	27.8	29.6	30.3	30.5	30.5	30.5	30.5
H26	12.3	17.8	23.5	27.6	29.4	30.1	30.3	30.3	30.3	30.3
H27	10.1	15.6	21.3	25.4	27.2	27.9	28.1	28.1	28.1	28.1
H28	9	14.5	20.2	24.3	26.1	26.8	27	27	27	27
H29	8.7	14.2	19.9	24	25.8	26.5	26.7	26.7	26.7	26.7
H30	7.8	13.3	19	23.1	24.9	25.6	25.8	25.8	25.8	25.8
H32	9.2	14.7	20.4	24.5	26.3	27	27.2	27.2	27.2	27.2
H33	8.5	14	19.7	23.8	25.6	26.3	26.5	26.5	26.5	26.5
H34	7.9	13.4	19.1	23.2	25	25.7	25.9	25.9	25.9	25.9

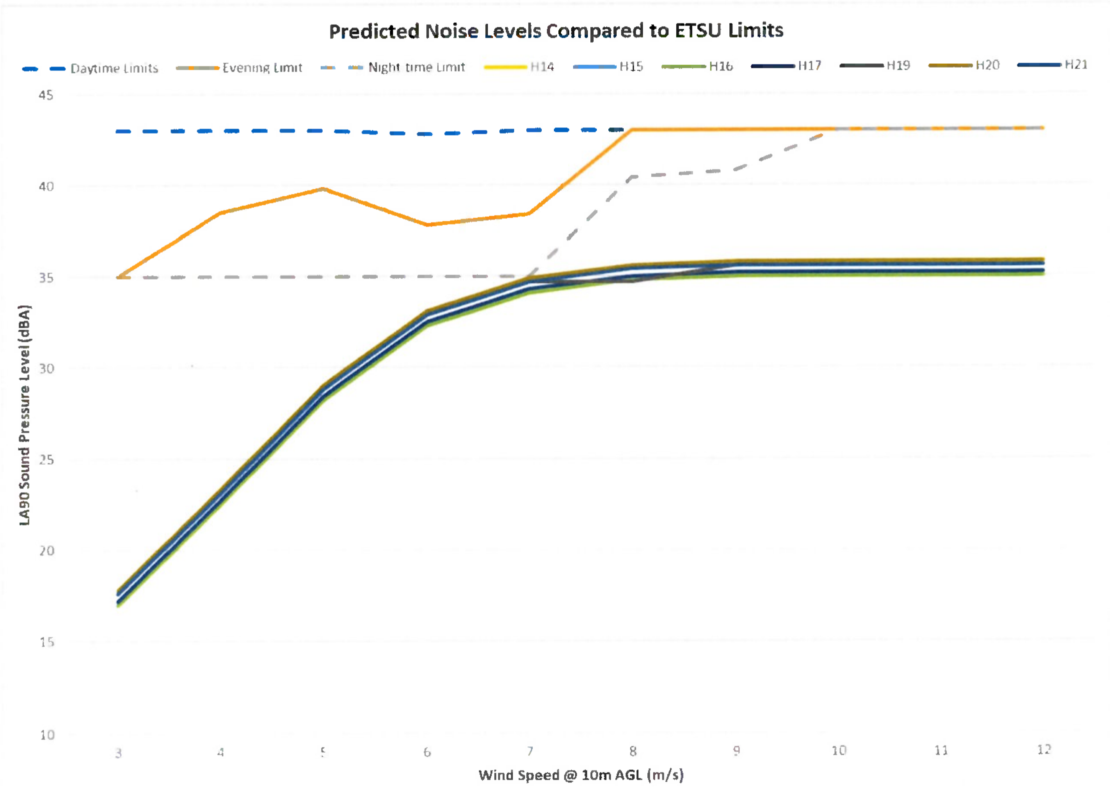
Figure 5: Predicted Noise Level Compared to WEDG Limits (Financially Involved Properties)



It can be seen from Table 5 and Figure 5 that the predicted noise levels at each of the financially involved properties comply with the appropriate WEDG19 limits.

All other sensitive receptors located further away from the proposed Graffy Wind Farm are not predicted to experience noise levels as high as the locations identified above.

Figure 6: Predicted Noise Level Compared to WEDG Limits (Third Party Properties)



It can be seen from Table 5 and Figure 6 that the predicted noise levels at each of the third-party properties comply with the appropriate WEDG19 limits.

All other sensitive receptors located further away from the proposed Graffy Wind Farm are not predicted to experience noise levels as high as the locations identified above.

5.14 Results –Nordex N133 (with Serrated Trailing Edge)

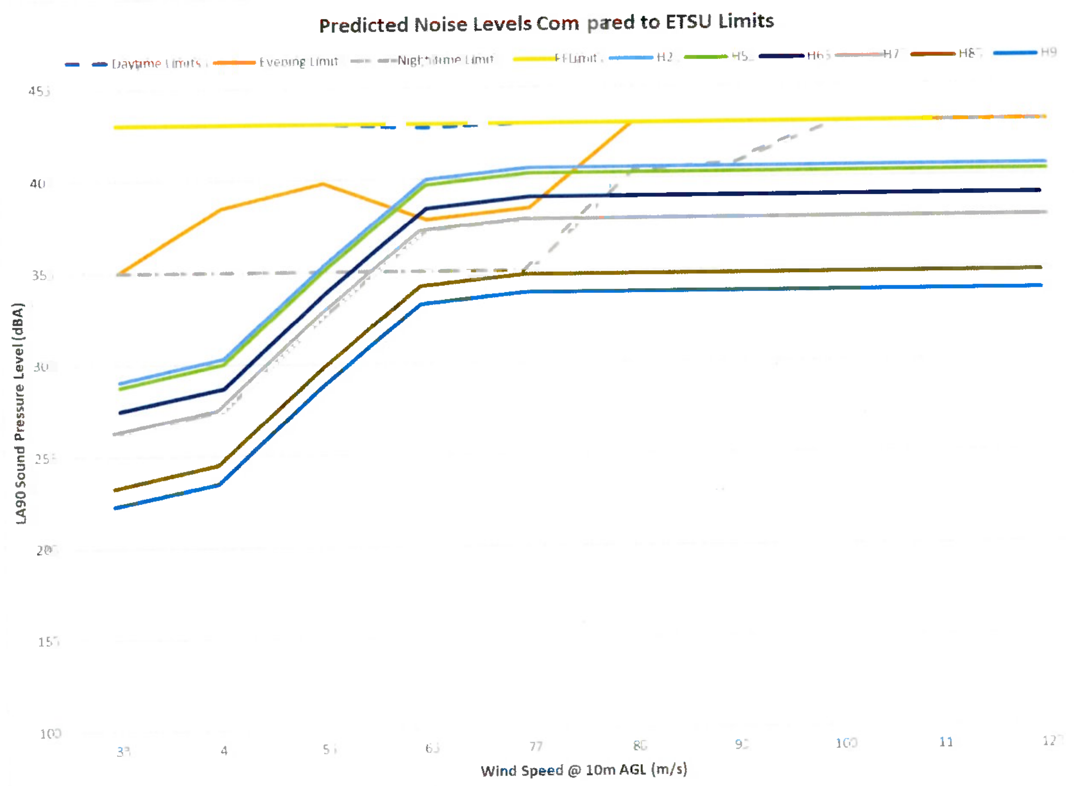
The predicted noise levels as a result of the operation of the proposed Windfarm comprising of eight Nordex N133 turbines are provided in Table 6 and Figure 7 and 8 below, with a noise map provided in Appendix E showing the noise contours. The results have been compared to WEDG limits.

Table 6: Predicted L_{A90} Noise Levels Compared to WEDG Limits

Wind Speed, m/s	Predicted L_{A90} Noise Level (dB)									
	3	4	5	6	7	8	9	10	11	12
Daytime Limit	**43**	**43**	**43**	**42.8**	**43**	**43**	**43**	**43**	**43**	**43**
Evening Limit	**35**	**38.5**	**39.8**	**37.8**	**38.4**	**43**	**43**	**43**	**43**	**43**
NT Limit	**35**	**35**	**35**	**35**	**35**	**40.4**	**40.8**	**43**	**43**	**43**
H2 (FI)	29.1	30.3	35.4	40	40.6	40.6	40.6	40.6	40.6	40.6
H5 (FI)	28.8	30	35.1	39.7	40.3	40.3	40.3	40.3	40.3	40.3
H6 (FI)	27.5	28.7	33.8	38.4	39	39	39	39	39	39
H7 (FI)	26.3	27.5	32.6	37.2	37.8	37.8	37.8	37.8	37.8	37.8
H8 (FI)	23.3	24.5	29.6	34.2	34.8	34.8	34.8	34.8	34.8	34.8
H9 (FI)	22.3	23.5	28.6	33.2	33.8	33.8	33.8	33.8	33.8	33.8
H11	21	22.2	27.3	31.9	32.5	32.5	32.5	32.5	32.5	32.5
H12	19	20.2	25.3	29.9	30.5	30.5	30.5	30.5	30.5	30.5
H14	23.9	25.1	30.2	34.8	35.4	35.4	35.4	35.4	35.4	35.4
H15	23.9	25.1	30.2	34.8	35.4	35.4	35.4	35.4	35.4	35.4
H16	23.9	25.1	30.2	34.8	35.4	35.4	35.4	35.4	35.4	35.4
H17	24.1	25.3	30.4	35	35.6	35.6	35.6	35.6	35.6	35.6
H19	24.5	25.7	30.8	35.4	36	36	36	36	36	36
H20	24.8	26	31.1	35.7	36.3	36.3	36.3	36.3	36.3	36.3

Wind Speed, m/s	Predicted L_{A90} Noise Level (dB)									
	3	4	5	6	7	8	9	10	11	12
Daytime Limit	**43**	**43**	**43**	**42.8**	**43**	**43**	**43**	**43**	**43**	**43**
Evening Limit	**35**	**38.5**	**39.8**	**37.8**	**38.4**	**43**	**43**	**43**	**43**	**43**
NT Limit	**35**	**35**	**35**	**35**	**35**	**40.4**	**40.8**	**43**	**43**	**43**
H21	24.6	25.8	30.9	35.5	36.1	36.1	36.1	36.1	36.1	36.1
H23	21.6	22.8	27.9	32.5	33.1	33.1	33.1	33.1	33.1	33.1
H24	19.6	20.8	25.9	30.5	31.1	31.1	31.1	31.1	31.1	31.1
H25	19.4	20.6	25.7	30.3	30.9	30.9	30.9	30.9	30.9	30.9
H26	19.2	20.4	25.5	30.1	30.7	30.7	30.7	30.7	30.7	30.7
H27	17	18.2	23.3	27.9	28.5	28.5	28.5	28.5	28.5	28.5
H28	16	17.2	22.3	26.9	27.5	27.5	27.5	27.5	27.5	27.5
H29	15.6	16.8	21.9	26.5	27.1	27.1	27.1	27.1	27.1	27.1
H30	14.8	16	21.1	25.7	26.3	26.3	26.3	26.3	26.3	26.3
H32	16.1	17.3	22.4	27	27.6	27.6	27.6	27.6	27.6	27.6
H33	15.4	16.6	21.7	26.3	26.9	26.9	26.9	26.9	26.9	26.9
H34	14.8	16	21.1	25.7	26.3	26.3	26.3	26.3	26.3	26.3

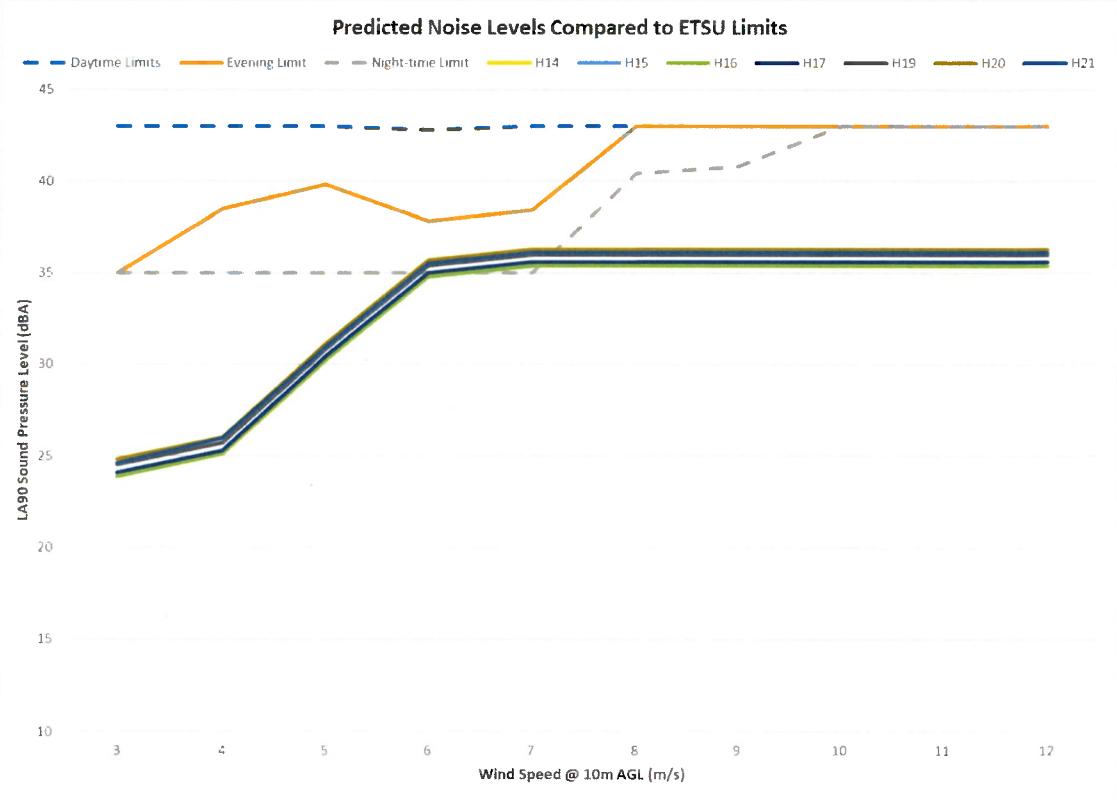
Figure 7: Predicted Noise Level Compared to WEDG Limits (Financially Involved Properties)



It can be seen from Table 6 and Figure 7 that the predicted noise levels at each of the financially involved properties comply with the appropriate WEDG19 limits.

All other financially involved sensitive receptors located further away from the proposed Graffy Wind Farm are not predicted to experience noise levels as high as the locations identified above.

Figure 8: Predicted Noise Level Compared to WEDG Limits (Third Party Properties)



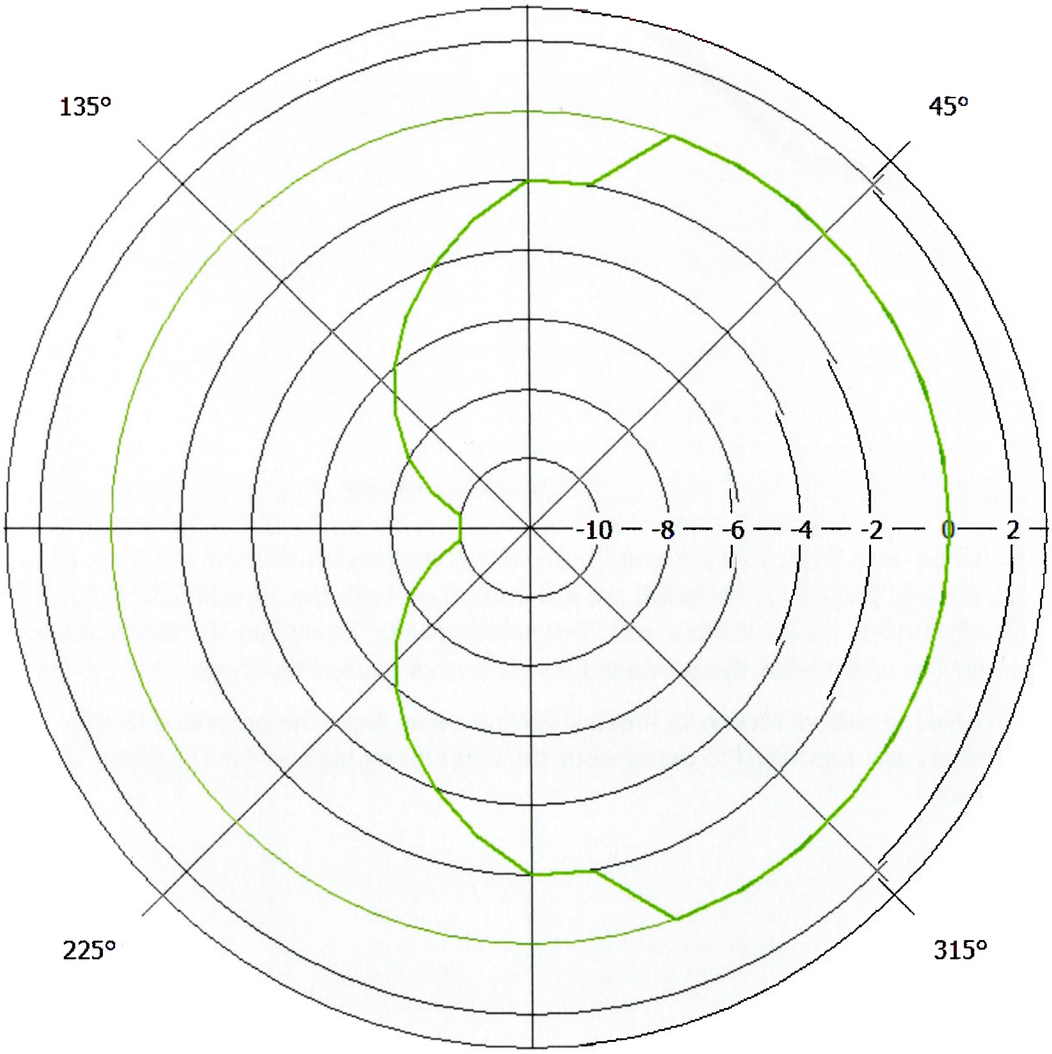
It can be seen from Table 6 and Figure 8 that the predicted noise levels at each of the third-party properties included are not compliant with the appropriate WEDG19 limit for night-time hours at 6m/s and 7m/s wind speeds. Therefore, further assessment is needed to ensure that the predicted levels do not exceed the limits at these receptors.

All other sensitive receptors located further away from the proposed Graffy Wind Farm are not predicted to experience noise levels as high as the locations identified above.

5.15 DIRECTIVITY

The predictions made using ISO 9613-2 are "worst-case" conditions, which reflect the scenario where the source to receiver propagation is always in a downwind direction. When considering cumulative impacts from wind turbines the IOA GPG does provide a methodology which allows wind direction to be taken into account. As per Section 4.4.2 of the GPG, the predicted noise levels were reduced by 2dB when the wind was in the region 80-90° from downwind, with a 10dB reduction to the predicted noise levels when in an upwind direction. A typical directivity plot is presented in Figure 9.

Figure 9 – Directivity plot for Westerly wind direction



Appendix G presents the predicted noise impacts at 6m/s and 7m/s wind speed across the 8 points of the compass, without the curtailment strategy in place. It shows how the application of directivity effects the predicted noise levels – receptors that were only slightly in exceedance at certain wind speeds and directions are now in compliance.

5.16 CURTAILMENT STRATEGY

The following curtailment strategy has been tailored to ensure that noise levels from the proposed Graffy Wind Farm with eight Nordex N133 turbines is in compliance with the calculated noise limits. The operating modes displayed are derived from the Nordex Noise level, power curves, thrust curves – Nordex N133 dated 20 October 2020.

Table 7: Directional mitigation for Graffy Wind Farm – 6m/s at night-time

Wind Direction (blowing from)	Turbine							
	T1	T2	T3	T4	T5	T6	T7	T8
North	Full	Full	Full	Full	Full	Full	Full	Full
North East	Full	Full	Full	Full	Full	Full	Full	M5
East	Full	Full	Full	Full	Full	Full	Full	M5
South East	Full	Full	Full	Full	Full	Full	Full	M4
South	Full	Full	Full	Full	Full	Full	Full	Full
South West	Full	Full	Full	Full	Full	Full	Full	Full
West	Full	Full	Full	Full	Full	Full	Full	Full
North West	Full	Full	Full	Full	Full	Full	Full	Full

Table 8: Directional mitigation for Graffy Wind Farm – 7m/s at night-time

Wind Direction (blowing from)	Turbine							
	T1	T2	T3	T4	T5	T6	T7	T8
North	Full	Full	Full	Full	Full	Full	Full	M2
North East	Full	Full	Full	Full	Full	Full	M1	M5
East	Full	Full	Full	Full	Full	Full	M1	M5
South East	Full	Full	Full	Full	Full	Full	Full	M5
South	Full	Full	Full	Full	Full	Full	Full	Full
South West	Full	Full	Full	Full	Full	Full	Full	Full
West	Full	Full	Full	Full	Full	Full	Full	Full
North West	Full	Full	Full	Full	Full	Full	Full	M2

Under these conditions the noise impact assessment shows that operation of all turbines in the vicinity of the site will comply with the WEDG19 limits as defined.

Appendix F presents the new calculated noise levels after the curtailment strategy has been implemented for each relevant wind direction.

As per Appendix F, no exceedances of the WEDG19 noise limits are presented, further to curtailment.

5.17 CUMULATIVE ASSESSMENT

The Wind Energy Development Guidelines recommend noise limits "to provide protection to wind energy development neighbours", with the implication that the limit applies cumulatively for noise from all wind energy developments at any given noise sensitive receptor. Therefore, for the proposed Graffy Windfarm, all consented and proposed wind turbines and Windfarms within 20 km of the proposed Windfarm were identified for the cumulative noise impact assessment. These developments are listed in Table 9:

Table 9: Proposed or existing turbines within 20km of the proposed Windfarm

Site	Distance from proposed Windfarm Centre (m)	Turbine Type	Hub Height (m)	Planning Reference(s)
Loughderryduff WF	15,845	Vestas V52/850	64	03/3043
Cullaigh WF	16,898	Vestas V47	45	-
Anarget	7,255	Enercon E-44 (3) Vestas V47 (3)	-	-
Corkermore	17,482	Gamesa G80	60	01/846 07/20592 07/20250 09/20517

Additional screening was undertaken to identify which of these existing or consented turbines may be capable of contributing cumulatively to wind energy noise levels at the closest receptors during operation of the proposed Graffy Windfarm. For each of the developments identified in Table 9: the highest contribution at any receptor location was calculated and compared with the lowest predicted level experienced at any receptor from the proposed Windfarm.

This screening assessment was carried out at a single wind speed of 9+ m/s where all of the turbines identified were modelled within SoundPLAN.

It was confirmed that the turbines within the wider area does not impact the predicted noise levels at any of the identified receptors, therefore no further cumulative assessment was required.

5.18 PREDICTED ENVIRONMENTAL EFFECTS DURING CONSTRUCTION AND DECOMMISSIONING

5.19 Construction Noise

The proposed windfarm will involve the construction of eight wind turbines together with their associated infrastructure, upgrade of existing tracks, construction of new access tracks, minor amendments to the public road including the installation of passing bays, road widening and construction of an underground grid connection, which will extend from the proposed wind farm substation along the public roads and through privately owned lands to the nearest substation.

The construction scheme will involve a number of key activities which have the potential to generate noise, namely:

- Excavating and backfilling of access tracks and installation of underground grid line; and
- Construction of turbine and sub-station building foundations including the use of excavators along with pumping of concrete
- the delivery of turbine components, construction material in lorries, dumper trucks and tippers.

As the equipment is not yet located onsite, we were unable to carry out noise measurements for the specific equipment to be used. Table 10 shows indicative noise levels for specific activities as provided by BS5228.

Table 10: Typical Noise Levels from Construction Works (ref: BS 5228)

Activity	Plant	L_{Aeq} @ 10m
Site clearance/excavation	Lorries (drive by)	70 dB
	Dozers	87 dB
Removal of waste/rubble	HGV and tippers	84 dB
Foundations	Concrete Pour	to 80 dB
	Place and vibrate	to 86 dB
	concrete cycle Cement	80 dB
	Mixers	74 db
Concrete Frame	Large crane operations	86 dB
	Place and vibrate	80 dB
Road works/landscaping	Surfacing/rolling	76 - 86 dB
Infilling/Levelling	Dump truck	82 dB
	Wheeled excavator/Loader	76 dB
	Dozer	81 – 89 dB

5.20 Construction of Windfarm

While there will be construction carried out across the extended wind farm site, all works for turbine installation will be in excess of approximately 725m from the nearest third-party residential properties.

The attenuation due to distance can be calculated using the following formula:

$$L2 = L1 - 20 \text{ Log } (r_2/r_1)$$

Where:

L2	=	noise level at receptor (dB)
L1	=	measured noise level (dB)
r_2	=	distance to receiver (725m)
r_1	=	measurement distance (10m)

The noise level of any specific equipment operating on the site will have a resultant L_{Aeq} noise level at a distance of 725m is predicted to be in the region of 33dB less than the 70dB L_{Aeq} limit specified by BS 5228-1:2009.

5.21 Construction of Grid Connection and Haul Route (Temporary Public Road Amendments).

The grid connection cable for Graffy Windfarm will be installed underground.

Construction work will be distant to residential and road user receptors. The excavation, installation and reinstatement process will on average take 1 day to complete approximately 100m section. It is anticipated that works will only be conducted in normal working hours of Monday to Friday 08:00 to 18:00 and Saturday 08:00 to 16:00 (if required).

Pulling the cable will take approximately 1 day. Jointing of cables will take approximately 1 day.

For the purpose of this assessment, a day is defined as between 0800 – 2000hrs.

The noise associated with the grid connection will only be during daylight working hours and days during the construction phase so there will be no additional contribution to the operational noise from the grid connection after construction.

5.21.1 BS 5228:2009+A1:2014

This document is used in the assessment of noise from construction of the grid connection.

BS 5228:2009+A1:2014 recommends procedures for noise and vibration control in respect of construction sites. It provides indicative noise levels from various pieces of plant and equipment as well as providing noise limits at nearby properties.

Noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut. The noise can be measured with a simple sound level meter, as we hear it, in A-weighted decibels (dBA). Noise levels, between 0700hrs and 1900hrs, outside the nearest window of the occupied room closest to the site boundary should not exceed:

- 70 decibels (dBA) in rural, suburban and urban areas away from main road traffic and industrial noise
- 75 decibels (dBA) in urban areas, near main roads, in heavy industrial areas

The cable route corridor is considered to be within a rural area, therefore a target L_{Aeq} noise level of 70dB at the nearest window of the residential properties in the vicinity of the corridor is considered appropriate.

5.21.2 EQUIPMENT

Equipment used to install underground cable and complete construction of the necessary temporary road amendments are detailed in Table 11. Also included are source noise levels taken from BS 5228:2009+A1:2014.

Table 11: Source Noise Levels from Construction Works (ref: BS 5228)

Equipment	BS 5228 reference	LAeq at 10m
Excavator	Table C5 No.11	73
Tractor	Table C4 No.74	80
Stihl Saw	Table C4 No.70	91
Small Excavator	Table C4 No.10	66
Compactor	Table D3 No.118	89
Cable Percussion Drilling Rig	Table C.2 No.43	74
Directional Drill (Generator)	Table C.2 No.44	77

5.21.3 ASSESSMENT

The source noise levels detailed in Table 11 are combined to give a cumulative noise level at 10m using the distance attenuation calculation detailed above.

The noise level is predicted at intervals of 5m, as detailed in Table 12.

Table 12: Cumulative Noise Level

Distance	L_{Aeq}	Distance
10	93.5	10
15	90	15
20	83.9	20
25	76	25
30	66.4	30

Where construction occurs at a distance of 30m or greater from a property, the construction noise level is expected to be below the target noise level of 70dB L_{Aeq}.

Where construction occurs less than 30m from a property, the target noise level is expected to be exceeded, however, at a cable-laying rate of 100m per day, the equipment would only be expected to be within 30m of a property for a maximum of 6 daylight, working hours, if the construction occurs directly past the property. This will reduce the impact significantly. It should be noted that as a conservative measure during the prediction process, the equipment detailed above is assumed to be operating simultaneously, whereas in practice this is unlikely to be the case and therefore lower noise levels would be expected in reality.

Potential noise impacts to residents resulting from the installation of the proposed grid connection and haul route are not considered to be significant and are in compliance with the recommendations outlined in BS 5228:2009+A1:2014.

5.21.4 DECOMMISSIONING NOISE

In the same way as for the construction perio d,it is anticipated that the activities associated with the future decommissioning of the wind turbines and grid connection would be confined to days of the week and hours of working as agreed with the local authority.

It is unlikely that this activity would lead to disturbance since it is expected that decommissioning of the turbines will be generally similar to, the construction phase, carried out at similar locations, with significant distances between the source and the receptors. Many of the activities involved and the noise levels generated would be broadly similar.

Decommissioning of the grid route would not involve the construction works and machinery associated with the construction of the same.

5.22 CONCLUSION

Irwin Carr has been asked to assess the noise impact of the proposed Graffy Windfarm, its associated Grid connection in Co. Donegal and haul route.

A noise impact assessment has been conducted according to the recommended draft Wind Energy Development Guidelines 2019 (WEDG19) methodology.

The predicted noise levels at each dwelling in closest proximity to the proposed Windfarm site were calculated in accordance with ISO9613-2:1996 under a range of operating wind speeds. The predicted noise levels have been compared with the corresponding noise limits.

It was found that the highest potential noise levels from the proposed wind turbine comply with the appropriate noise limit for the daytime, evening and night-time periods, as defined by WEDG19 as the appropriate noise limits.

In addition, a cumulative assessment was undertaken considering all further proposed, approved and operational wind energy developments within 20 km of the proposed development, where it was confirmed that there was no impact on the predicted noise levels from turbines in the wider vicinity of the site.

Potential noise impacts to residents resulting from the installation of the proposed grid connection and haul route are not considered to be significant and are in compliance with the recommendations outlined in BS 5228:2009+A1:2014.

All non-assessed sites further from the wind turbine will experience worst-case noise levels lower than the residential properties assessed in this report and therefore will also comply with the fixed limits within the WEDG19 document.

For the reasons outlined within this report, Irwin Carr Consulting is of the opinion that noise should not be considered a determining factor for this site, further to implementing the outlined curtailment strategy.

APPENDIX A ACOUSTIC TERMINOLOGY

Ambient The ambient noise level is the noise level measured in the absence of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to the addition of a new noise source.

dB Decibel. The unit of sound level.

dBA A-weighted decibel. The A-weighting approximates the response of the human ear.

Frequency Sound can occur over a range of frequencies extending from the very low, such as the rumble of thunder, up to the very high such as the crash of cymbals. Sound is generally described over the frequency range from 63Hz to 4000Hz (4kHz). This is roughly equal to the range of frequencies on a piano.

Octave band Sound, which can occur over a range of frequencies, may be divided into octave bands for analysis. The audible frequency range is generally divided into 7 octave bands. The octave band frequencies are 63Hz, 125Hz, 250Hz, 1kHz, 2kHz and 4kHz.

$L_{Aeq\,(t)}$ The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level.

The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.

Noise is often not steady. Traffic noise, music noise and the barking of dogs are all examples of noises that vary over time. When such noises are measured, the noise level can be expressed as an average level, or as a statistical measure, such as the level exceeded for 90% of the time.

L_{90} The noise level exceeded for 90% of the measurement period. This is commonly referred to as the background noise level.

APPENDIX B NOISE PREDICTION MODEL

The ISO9613-2: 1996 propagation model predicts sound pressure level at a field point using equation [2]:

$L_p = L_{Wpoint} + D - A_{div} - A_{atm} - A_{ground} - A_{screen} - A_{misc}$
[2]

where:

- L_p is the sound pressure level at a field point
- L_{wpoint} is the sound power level of a point source
- D is the directivity index of the source in dB
- A_n are the attenuation allowances for geometrical divergence, atmospheric absorption, ground hardness, screening and miscellaneous effects.

L_{wpoint} – Point Source Sound Power Level

Sound power level data measured according to IEC-61400-11 Wind Turbine Generator Systems – Part 11: Acoustic Noise Measurement Techniques (IEC 61400-11:2006) is used. This data is expressed in terms of A-weighted decibels (dBA), for each integer multiple of the wind speed range of interest in addition to linear 1/3 octave values from 50Hz to 10kHz or octave band values from 63Hz to 8kHz.

D – Directivity Factor

The directivity factor (D) allows for an adjustment to be made to the radiated sound power level where the source is understood to radiate higher levels of sound in the direction of interest. Accordingly no directivity corrections have been used in our model.

A_{div} – Unidirectional Spherical Divergence

For ISO 9613-2:1996 a turbine is considered to be a point source radiating sound energy in a free-field. As such, sound energy propagating distance (r) will be attenuated according to the following equation:

$A_{div} = 20\log(r) + 11\text{dB}$ [3]

A_{atm} – Atmospheric Absorption

Sound propagation through the atmosphere is considered to be a diabatic process in that as the wave front propagates outwards from the source, energy is converted to heat. The attenuation provided by this process is largely dependent on the relative humidity and temperature of the air through which the sound propagates.

A_{ground} – Ground Effect

The ISO9613-2:1996 standard describes three distinct ground surface types, namely hard, porous and mixed ground and states the following:

Hard ground includes paving, water, ice, concrete and all other ground surfaces having a low porosity.

Porous ground includes ground covered by grass, trees and other vegetation, and all other ground surfaces suitable for growth of vegetables, such as farming land.

Mixed ground consists of both hard and porous ground.

For the purposes of this assessment the ground factors were assumed to be 0.5

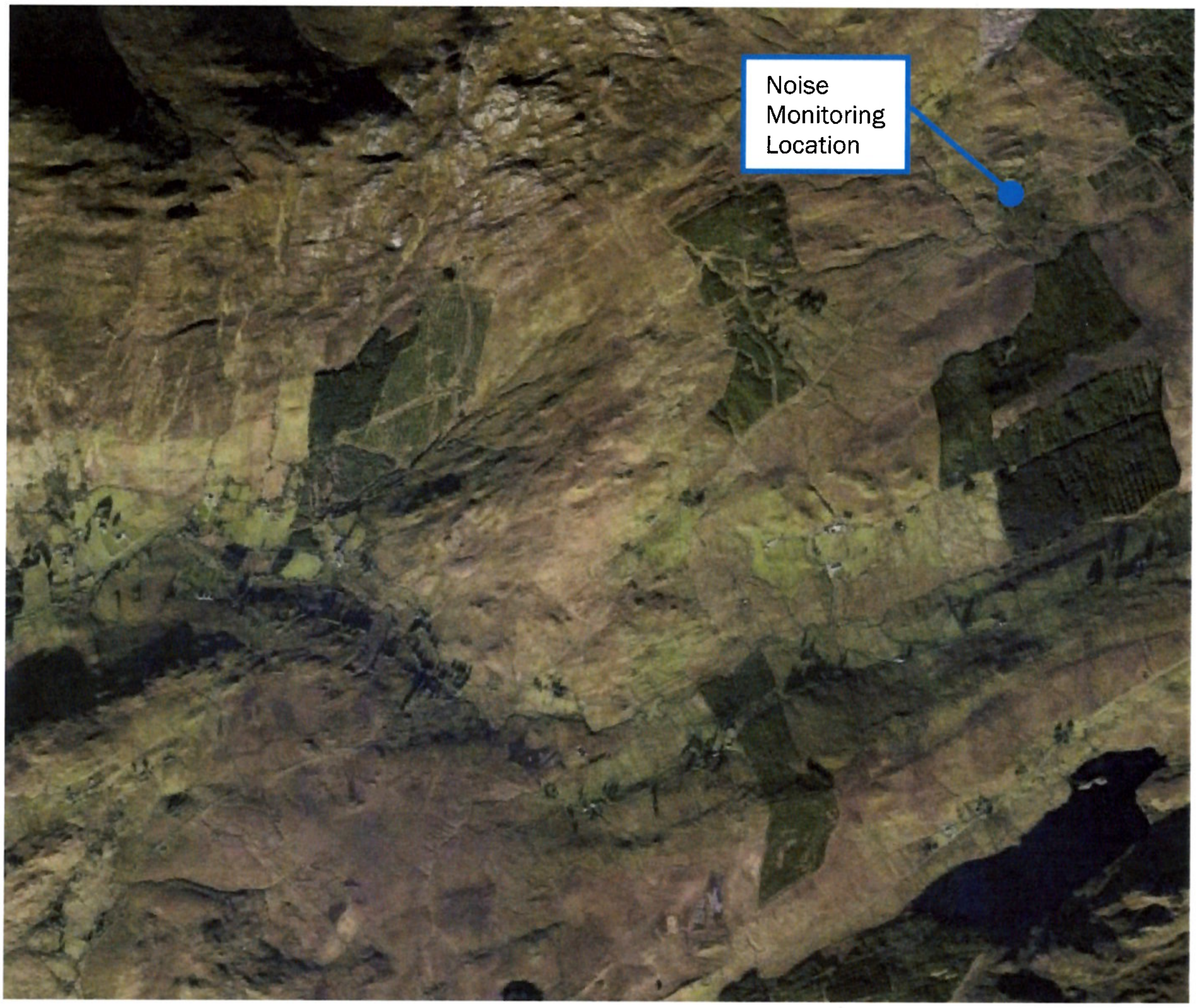
A_{screen} – Acoustic Screening

No barrier attenuation assumptions have been used within this model. It should be noted that attenuation due to topographic screening is inherently calculated by SoundPLAN from the digital terrain file.

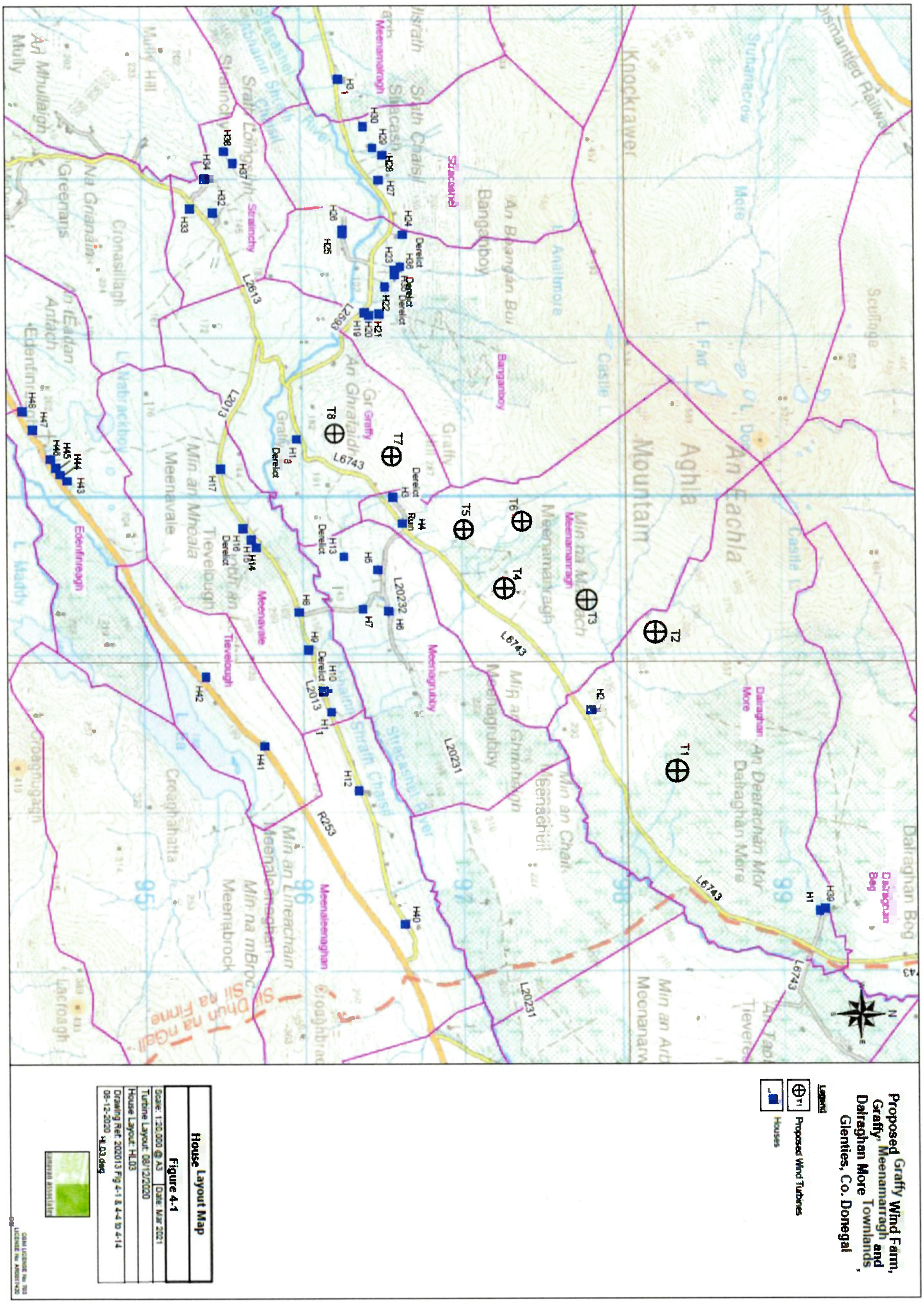
A_{misc} – Miscellaneous Effects

No miscellaneous attenuation effects have been used within this model.

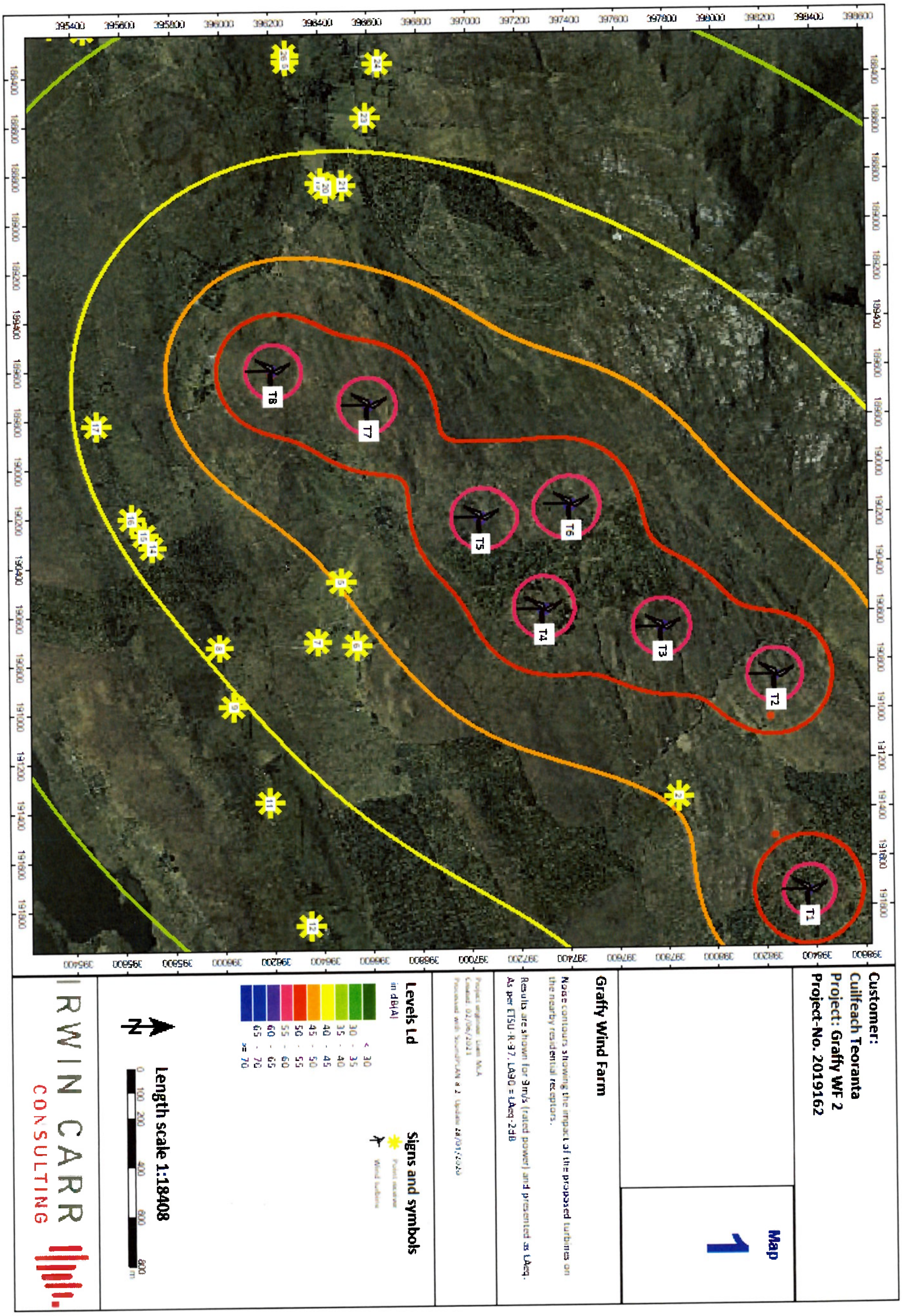
APPENDIX C NOISE MONITORING LOCATIONS

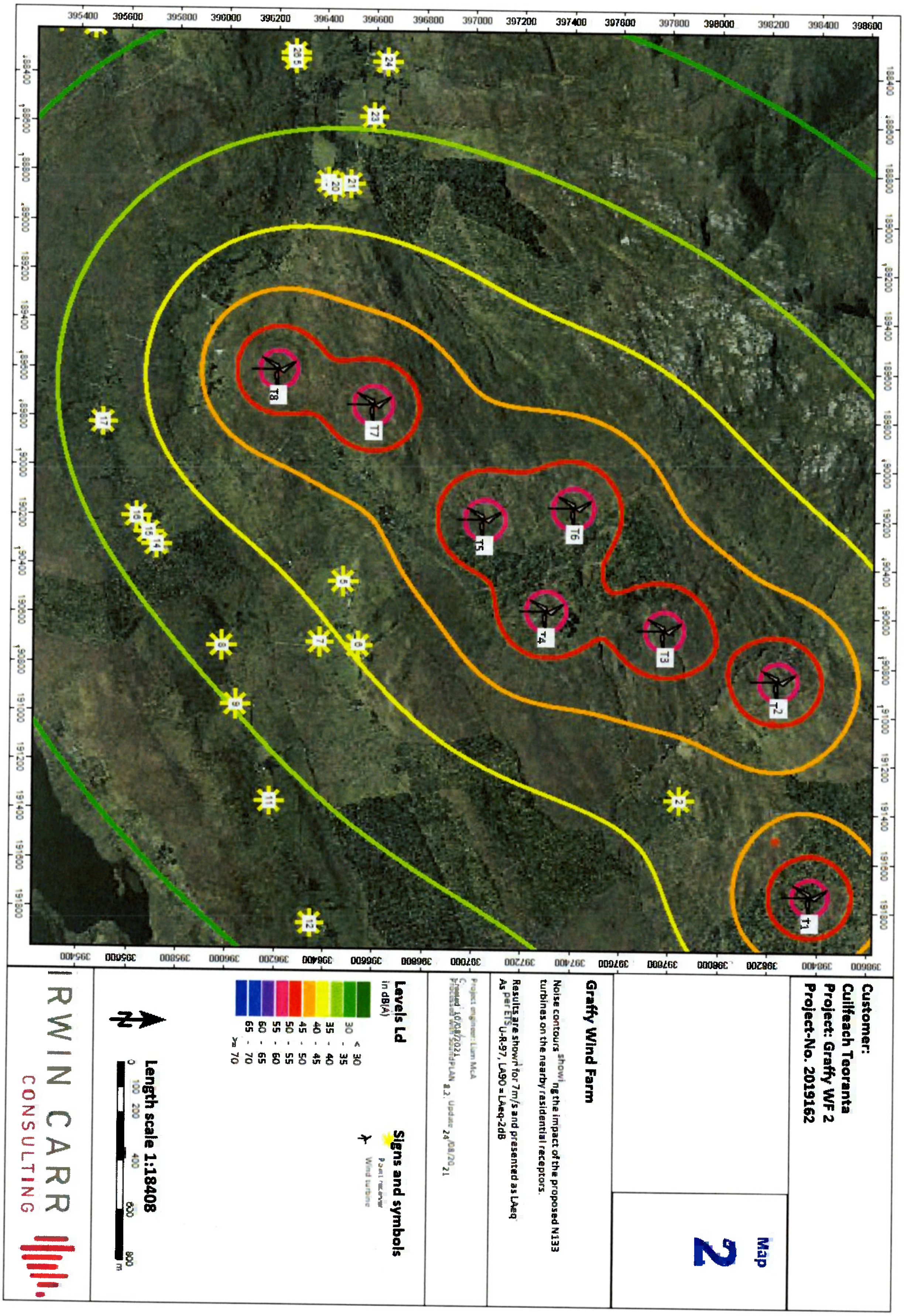


APPENDIX D TURBINE AND RECEPTOR LOCATIONS



APPENDIX E SOUNDPLAN NOISE MODEL




Customer:
Cuilfeach Teoranta
Project: Graffy WF 2
Project-No. 2019162
Map
2
Graffy Wind Farm
Noise contours showing the impact of the proposed N133 turbines on the nearby residential receptors.
Results are shown for 7m/s and presented as LAeq
As per ETSU-R-97, LA90 = LAeq-2dB
Levels Ld
in dB(A)
< 30
30 - 35
35 - 40
40 - 45
45 - 50
50 - 55
55 - 60
60 - 65
65 - 70
>= 70
Signs and symbols
Point receiver
Wind turbine
Length scale 1:18408
0 100 200 400 600 800 m
IRWIN CARR
CONSULTING

APPENDIX F CURTAILMENT STRATEGY RESULTS

6m/s Wind Speed	Wind Direction		
Receptor	North East	East	South East
H2 (FI)	37.1	35.9	35.1
H5 (FI)	38.4	35	32.5
H6 (FI)	36.7	33.4	30.5
H7 (FI)	35.3	32.2	29.2
H8 (FI)	32.6	29.1	25.8
H9 (FI)	31.4	27.9	24.7
H11	29.7	25.8	23
H12	27.2	23.4	21.2
H14	32.8	29.8	26
H15	33	29.9	26.1
H16	33.3	30	26.1
H17	34	31.4	27.3
H19	34.6	34.6	34.6
H20	34.9	34.9	34.9
H21	34.7	34.7	34.7
H23	31.9	31.9	31.9
H24	30	30	30
H25	29.6	29.6	29.6
H26	29.4	29.4	29.4
H27	27.3	27.3	27.4
H28	26.3	26.3	26.4
H29	26	26	26.1
H30	25.1	25.1	25.2
H32	26.3	26.3	25
H33	25.6	25.6	23.9
H34	25	25	24

7m/s Wind Speed	Wind Direction				
Receptor	North	North East	East	South East	North West
H2 (FI)	39.5	37.7	36.5	35.7	39.9
H5 (FI)	39.6	38.9	35.6	33	40.2
H6 (FI)	38.6	37.3	34	31	38.9
H7 (FI)	37.2	35.9	32.7	29.7	37.7
H8 (FI)	34.3	33.1	29.6	26.2	34.6
H9 (FI)	33.5	31.9	28.4	25.1	33.7
H11	32.1	30.2	26.4	23.5	32.4
H12	30.2	27.8	24	21.7	30.4
H14	35	33.1	30.2	26.4	35
H15	35	33.3	30.3	26.4	35
H16	34.9	33.5	30.4	26.4	34.9
H17	35	34.1	31.7	27.5	35
H19	33.8	34.8	34.8	34.8	30
H20	33.8	35	35	35	30.1
H21	33.6	34.9	34.9	34.9	29.7
H23	30.9	32.1	32.1	32.2	26.7
H24	28.9	30.2	30.2	30.4	24.7
H25	29.4	29.9	29.9	29.8	25.5
H26	29.2	29.7	29.7	29.6	25.2
H27	26.7	27.6	27.6	27.7	22.5
H28	25.6	26.6	26.6	26.7	21.4
H29	25.4	26.3	26.3	26.4	21.2
H30	24.6	25.4	25.4	25.5	20.5
H32	27.2	26.5	26.5	25.1	24.2
H33	26.5	25.8	25.8	24.1	23.8
H34	25.9	25.3	25.3	24.2	22.7

APPENDIX G DIRECTIVITY RESULTS

6m/s Wind Speed	Wind Direction							
Receptor	North	North East	East	South East	South	South West	West	North West
H2 (FI)	38.9	37.1	35.9	35.1	36.8	38.2	39.1	39.3
H5 (FI)	39	38.4	35.1	32.8	34.6	37.1	39.2	39.7
H6 (FI)	38	36.7	33.5	30.7	32.8	35.9	37.8	38.4
H7 (FI)	36.7	35.4	32.2	29.5	31.3	34.7	36.6	37.2
H8 (FI)	33.9	32.7	29.2	26.1	28.1	31.7	33.8	34.2
H9 (FI)	33	31.5	28	24.9	27.2	31.1	32.9	33.2
H11	31.6	29.7	25.9	23.2	26.2	29.8	31.7	31.9
H12	29.6	27.3	23.4	21.3	24.7	28.3	29.7	29.9
H14	34.8	33.3	30.1	26.4	27.8	31.5	34.2	34.8
H15	34.8	33.5	30.3	26.5	27.6	31.5	34.3	34.8
H16	34.8	33.9	30.5	26.5	27.2	31.4	34.3	34.8
H17	35	35	32.3	27.9	25.6	29.6	33.8	35
H19	33.5	35.4	35.4	35.3	33.2	29	26.2	29.7
H20	33.6	35.7	35.7	35.5	33.7	29.4	26.5	29.8
H21	33.3	35.5	35.5	35.3	33.9	29.5	26.4	29.4
H23	30.5	32.5	32.5	32.4	30.9	26.4	23.3	26.3
H24	28.5	30.5	30.5	30.5	28.8	24.4	21.2	24.3
H25	29.1	30.3	30.3	30.1	27.3	23	21.1	25.1
H26	28.9	30.1	30.1	29.9	27.1	22.7	20.8	24.9
H27	26.3	27.9	27.9	27.9	25.2	21.1	18.4	22.1
H28	25.2	26.9	26.9	26.8	24.1	20.1	17.3	21
H29	25	26.5	26.5	26.5	23.7	19.6	17	20.9
H30	24.2	25.7	25.7	25.6	22.8	18.5	16.1	20.1
H32	27	27	27	25.7	21.6	17.3	19.5	24
H33	26.3	26.3	26.3	24.6	20.6	16.5	19.1	23.6
H34	25.7	25.7	25.7	24.7	20.6	16.2	18	22.5

7m/s Wind Speed				Wind Direction				
Receptor	North	North East	East	South East	South	South West	West	North West
H2 (FI)	39.5	37.7	36.5	35.7	37.4	38.8	39.7	39.9
H5 (FI)	39.6	39	35.7	33.4	35.2	37.7	39.8	40.3
H6 (FI)	38.6	37.3	34.1	31.3	33.4	36.5	38.4	39
H7 (FI)	37.3	36	32.8	30.1	31.9	35.3	37.2	37.8
H8 (FI)	34.5	33.3	29.8	26.7	28.7	32.3	34.4	34.8
H9 (FI)	33.6	32.1	28.6	25.5	27.8	31.7	33.5	33.8
H11	32.2	30.3	26.5	23.8	26.8	30.4	32.3	32.5
H12	30.2	27.9	24	21.9	25.3	28.9	30.3	30.5
H14	35.4	33.9	30.7	27	28.4	32.1	34.8	35.4
H15	35.4	34.1	30.9	27.1	28.2	32.1	34.9	35.4
H16	35.4	34.5	31.1	27.1	27.8	32	34.9	35.4
H17	35.6	35.6	32.9	28.5	26.2	30.2	34.4	35.6
H19	34.1	36	36	35.9	33.8	29.6	26.8	30.3
H20	34.2	36.3	36.3	36.1	34.3	30	27.1	30.4
H21	33.9	36.1	36.1	35.9	34.5	30.1	27	30
H23	31.1	33.1	33.1	33	31.5	27	23.9	26.9
H24	29.1	31.1	31.1	31.1	29.4	25	21.8	24.9
H25	29.7	30.9	30.9	30.7	27.9	23.6	21.7	25.7
H26	29.5	30.7	30.7	30.5	27.7	23.3	21.4	25.5
H27	26.9	28.5	28.5	28.5	25.8	21.7	19	22.7
H28	25.8	27.5	27.5	27.4	24.7	20.7	17.9	21.6
H29	25.6	27.1	27.1	27.1	24.3	20.2	17.6	21.5
H30	24.8	26.3	26.3	26.2	23.4	19.1	16.7	20.7
H32	27.6	27.6	27.6	26.3	22.2	17.9	20.1	24.6
H33	26.9	26.9	26.9	25.2	21.2	17.1	19.7	24.2
H34	26.3	26.3	26.3	25.3	21.2	16.8	18.6	23.1

6.Soils, Geology & Hydrogeology

Contents

Contents

6. SOILS, GEOLOGY & HYDROGEOLOGY

6.1. Introduction

This chapter of the EIAR addresses soils, geology and hydrogeology in the existing environment, the potential direct and indirect impacts of the proposed development there on, and the proposed mitigation measures to avoid or reduce potential impacts. The other nearest operational and permitted wind farms are too distant to contribute to a cumulative impact on the geological aspects of the environment.

A full description of the proposed development is provided in Chapter 2. In summary the development will consist of a wind farm with 8 No. turbines, access roads, hardstands, substation, underground grid connection and improvements to the turbine delivery route. Sections of the wind farm roads and the delivery route upgrade pass through commercial forestry and one turbine is located in commercial forestry, so 'keyhole' felling will be required prior to road construction. A permanent met mast will also be erected at the location of the existing temporary met mast.

This chapter was prepared by Keohane Geological & Environmental Consultancy (KGEC). KGEC is a Cork-based consultancy specialising in geological and environmental sciences. Mr. Keohane has over 25 years' experience in environmental assessment. In the past 20 years, KGEC has prepared planning applications, EISs and/or geotechnical assessments for over 40 wind farm developments throughout Ireland and UK. He has also been involved in the construction of over 30 wind farms in Ireland.

6.1.1. Scope & Purpose

This chapter of the EIAR provides details of the geological environment in which the development is proposed. It identifies the overburden types, depth to bedrock, bedrock type, geological heritage sites, etc. It assesses the potential for peat landslide risk, including construction-related peat landslide risk.

The purpose of the assessment is to qualify the geological importance of the receiving environment, identify and quantify the potential direct impacts of the proposed development on geology within the site and potential indirect impacts beyond the site boundary; to assess the potential impacts in the context of other developments (proposed / completed) to determine cumulative effects. Having identified and quantified the potential impacts, to recommend measures to avoid, mitigate and/or reduce significant potential negative impacts for the construction and operational phases of the development. To audit the effectiveness of the mitigation measures, a construction monitoring programme is also outlined.

6.1.2. Policies & Guidelines

There are several local, national and international policies and guidelines relied upon in the preparation of this chapter. These include:

1. County Donegal Development Plan 2018-2024.
2. Department of the Environment, Heritage & Local Government, June 2006. *Wind Farm Development – Planning Guidelines.*
3. Department of Housing, Planning and Local Government, December 2019. *Draft Revised Wind Energy Development Guidelines.*
4. Irish Wind Energy Association, 2012, *Best Practice Guidelines for the Irish Wind Energy Industry.*
5. Environmental Protection Agency, 2002. Guidelines on the information to be contained in Environmental Impact Statements.
6. Environmental Protection Agency, August 2017. Guidelines on the information to be contained in Environmental Impact Statement Reports – draft.
7. Environmental Protection Agency, 2003. Advice Notes on current practice in the preparation of Environmental Impact Statements.
8. National Roads Authority, 2008. Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.
9. Scottish Natural Heritage, 2013. Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms.
10. Scottish Natural Heritage, et al. 2019. Good Practice during Wind Farm Construction, 4th Edition.
11. ESB, 2012. HV Cables – General Construction Methodology.

Wind Farm Planning Guidelines

In relation to soils / geology, the 2006 Wind Energy Guidelines recommend the following scope of assessment:

- A geological assessment of the locality.
- A geotechnical assessment of the overburden and bedrock.
- A landslide and slope stability risk assessment.
- An assessment of bog burst or landslide hazard.
- Location of geological heritage areas.
- Location of any significant mineral or aggregate potential.
- Assessment of impacts on groundwater.
- Details of borrow pits and blasting proposals.

The 2019 draft revised wind energy Guidelines largely mirror the 2006 guidelines in terms of the scope of soils/geology assessment. In addition to the above, the draft revised Guidelines require an assessment of peatland hydrology and carbon balance. The hydrology of the site is addressed in Chapter 7 (Water). Carbon balance is addressed in Chapter 8 (Climate).

County Development Plan

Most of the objectives and policies in the County Development Plan relating to geology are associated with the extractive industry. The policy that is relevant to the proposed development is:

> **G-P-1**: *It is a policy of the Council to protect County Geological Sites (CGS). Accordingly, the Council will adopt a precautionary approach to development proposals with the potential to impact upon a CGS. Proposals should be accompanied by a detailed report from a competent person setting out the potential impact to ensure that an informed decision can be made. Where significant harm to the CGS is deemed likely, planning permission will not be granted unless there are overriding considerations of public importance to the County.*

6.1.3. Sources of Baseline Information

The main sources of baseline data and information relating to geology include:

1. Soils, bedrock, hydrogeology, heritage etc - Geological Survey of Ireland - www.gsi.ie
2. Archived maps and reports - Department of Communication, Climate Action & Environment - https://secure.dccae.gov.ie/goldmine/index.html
3. Land use - Environmental Protection Agency - www.epa.ie
4. Designated sites – National Parks & Wildlife Service www.npws.ie

The literature reviewed as part of the desk study included:

1. Geology of South Donegal, Geological Survey of Ireland (GSI), 1999.
2. Soils Association of Ireland and their Land Use Potential, M. J. Gardiner and T. Radford, National Soil Survey of Ireland, 1980.
3. Directory of Active Quarries and Pits in Ireland, GSI 2014.
4. Landslides in Ireland, GSI June 2006.
5. The Bogs of Ireland, Feehan and O'Donovan.
6. County Donegal Development Plan 2018-2024.
7. Memoir of Localities of Minerals of Economic Importance and Metalliferous Mines in Ireland, The Mining Heritage Society of Ireland, 1998.
8. Harley-Newman Planning Consultants, 2009. Mully-Graffy Wind Farm – Environmental Impact Statement.
9. McCarthy Keville O'Sullivan Planning & Environmental Consultants, 22 November 2017. Environmental Impact Assessment Report – Proposed Meenbog Wind Farm, County Donegal.

6.1.4. Assessment Methodology

The assessment of geology was carried out with reference to relevant policies, regulations and guidelines and following this general methodology:

1. The preliminary design of the proposed development was reviewed to identify elements which could have the potential to impact on geology.

2. Consultation was carried out with agencies with an interest in the geological environment, including GSI (refer to Section 7.1.5.).
3. A literature review was carried out to determine any policies and / or guidelines to which the proposal should have regard.
4. A desk-based assessment of the geological setting relevant to the proposed development was undertaken. This included a review of the planning documentation associated with the original planning application. No sensitive geological receptors were identified during the desk-based assessment.
5. A field survey was conducted to map peat depth and condition across the site, slope measurement, measurement of peat strength and collection of geological and geotechnical data.
6. Review of the ecology report prepared for the site by RPS Group to assess the interaction of geology/hydrogeology/hydrology with ecology.
7. Findings from the desk-based study and field surveys were used to modify the site layout. Alternatives were considered for turbine locations, substation location and wind farm access roads. Areas with steep slopes and deep peat were avoided in the site layout as far as possible. Further field surveys were carried out to assess any subsequent modifications to the site layout.

The site walkovers and collection of data were carried out on several occasions between October 2018 and December 2020. Data collected in 2009 was also used. Initial data collection was used to identify areas unsuitable for siting turbines or routing access roads – i.e. areas with steep gradients or with deep peat. This initial data was used as constraints to develop the site layout. As the layout was developed, additional data was collected to 'fine tune' the layout. This irritative process also had regard to other aspects of the environment in achieving the optimal layout balancing each aspect of the environment. Data was collected at the turbine locations and along the general alignment of the access roads. The data coverage was sufficient to allow a robust assessment of ground conditions at the site. Data collected included:

1. Measurement of peat depth using a metal probe.
2. Measurement of un-drained shear strength of the peat.
3. Measurement of unconfined compressive strength of the bedrock, where exposed.

4. Visual description of the soil, peat, rock, topography, drainage and ground conditions.
5. Location of wells used for drinking water supply.

The aspects considered in the assessment were peat/slope stability, bedrock and overburden geology, hydrogeology and the interaction of these with ecology. These are discussed in the sub-sections below.

The information collected during the desk-based assessment and site walkover were used to establish the importance, quality and sensitivity of the receiving soils / geology / hydrogeology environment. This follows the NRA (2008) guidelines as summarised in Tables 6-1 and 6-2 for soils / geology and hydrogeology, respectively.

Table 6-1: Estimation of Importance of Soil & Geology Attributes

Importance	Criteria	Typical Examples
Very High	Attribute has a high quality, significance or value on a regional or national scale Degree or extent of soil contamination is significant on a national or regional scale Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale*	Geological feature rare on a regional or national scale (NHA) Large existing quarry or pit Proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale Degree or extent of soil contamination is significant on a local scale Volume of peat and/or soft organic soil underlying route is significant on a local scale	Contaminated soil on site with previous heavy industrial usage Large recent landfill site for mixed wastes Geological feature of high value on a local scale (County Geological Site) Well drained and/or highly fertility soils Moderately sized existing quarry or pit Marginally economic extractable mineral resource

Importance	Criteria	Typical Examples
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 route is moderate on a local scale	Contam inated soil on site with previous light industrial usage Small recent landfill site for mixed wastes Moderately drained and/or moderate fertility soils Small existing quarry or pit Sub-economic extractable mineral resource
Low	Attribute has a low quality, significance or value on a local scale Degree or extent of soil contamination is minor on a local scale Volume of peat and/or soft organic soil underlying route is small on a local scale.	Large historical and/or recent site for construction and demolition wastes Small historical and/or recent landfill site for construction and demolition wastes Poorly drained and/or low fertility soils Uneconomically extractable mineral resource

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

Table 6-2: Estimation of Importance of Hydrog eology Attributes

Importance	Criteria	Typical Examples
Extremely High	Attribute has a high quality 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 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 – NHA status Regionally important potable water source supplying >2500 homes Inner source protection area for regionally important water source

Importance	Criteria	Typical Examples
High	Attribute has a high quality 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

6.1.5. Consultation

As part of the EIA process, consultation was carried out with organisations and individuals regarding the proposed development, namely GSI. The list of consultee bodies and their summarised response are contained in Table 1.1 and 1.1A in Chapter 1 (Introduction), while the consultee bodies scoping document and their responses are set out in Appendix 1 of Volume 3. The relevant response is summarised here and incorporated, where appropriate, into the avoidance, mitigation and monitoring proposals for the proposed wind farm development.

Geological Survey of Ireland

The GSI responded to the consultation request in May 2020 and made the following observations:

- Geoheritage: There is one geological heritage site in the vicinity of the proposed wind farm. This is a key contact of exposure of the Slieve Tooey Quartzite and the lower part of the Cranford Limestone located at Stralinchy. This is discussed in Section 7.2.1.

- Geological Mapping: Developers are encouraged to use the high-quality data on many aspects of the geological sciences available online from the GSI.
- Groundwater: Developers are encouraged to use the aquifer mapping available online from GSI.
- Geohazards: GSI has data on recorded landslides throughout Ireland and is involved with the landslide susceptibility mapping. It notes several landslide events recorded to the south of the site.
- Natural Resources: GSI has data on mineral and aggregate resources and this data is available online.
- Geotechnical: GSI holds the national database of geotechnical investigations submitted by industry. Reports and data are available online and it is recommended that they be consulted. GSI requests copies of any geotechnical reports prepared for the development. It also requests that any significant rock cuttings be left visible as rock exposures (for inspection by GSI).

6.2. Receiving Environment

The site is in the valleys of Stracashel and Stranagoppoge Rivers and along the foothills of Aghla Mountain. The Stranagoppoge River is part of the River Finn SAC – development is not proposed within the SAC. The landholding on which the proposed development is located, covers an area of approximately 430ha and varies in elevation from approximately 120mOD to 310mOD. Turbines are proposed between elevations of approximately 200mOD and 292mOD. Site location maps are provided as Drawings 19-014-000 and 019-014-001. Photographs showing the general ground conditions at each turbine location, substation location and grid connection route are provided in Appendix 6-1.

The site is currently used primarily for rough grazing. There are some areas planted with conifers and small areas used for turf cutting. Larger forestry plantations are located in the wider area.

6.2.1. Geological Heritage

The GSI - Irish Geological Heritage Section (IGH) and NPWS (National Parks and Wildlife Service) is undertaking a programme to identify and select important geological and geomorphological sites throughout the country for designation as NHAs (Natural Heritage Areas) – the Irish Geological Heritage Programme. This is being addressed under 16 different geological themes. For each theme, a larger number of sites from which to make the NHA selection are being examined, in order to identify the most significant scientifically. The criteria of designating the minimum number of sites to exemplify the theme means that many sites of national importance are not selected as the very best examples. However, a second tier of County Geological Sites (CGS) (as per the National Heritage Plan) means that many of these can be included in County Development Plans and receive a measure of recognition and protection through inclusion in the planning system. Table 5.13 of the CDP lists 114 geological heritage sites. The GSI are still in the process of finalizing these proposed sites.

As noted, the Council has a policy to protect geological heritage sites in the County (Policy G-P-1 refers). The GSI was contacted for the nearest designated sites to the proposed development. These are also available for viewing on the GSI web-viewer - https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=b245c2bd11a64162a1632ad6bccf8e34&scale=0. The audit report for County Donegal is in preparation by GSI Heritage Section. The nearest sites to the Graffy Wind Farm are audited and are:

1. Stralinchy (grid ref. 187500 395500). Key contact exposure of the upper part of the Slieve Tooey Quartzite and the lower part of the Cranford Limestone. The full extent of the contact (not always exposed) between the two Formations runs from about 186500 / 395000 north-eastwards to about 188500 / 396000. It is located approximately 500m to the south of the proposed grid route and approximately 2km west of the wind farm. It is designated as a Geological Site of County Importance.
2. Lough Finn (grid ref. 191365 401580). Lough Finn is a long, narrow lake set in a U-shaped valley at the north-western edge of the Blue Stack Mountains. The area shows an excellent example of an areally scoured landscape, and the north-western side of the lake is bounded by a particularly fine lateral moraine. Poorly-

sorted gravel and diamict comprising a morphologically impressive lateral moraine along the mountain face immediately above the lough. Scientifically important because it records a late phase of ice sheet decay as the Donegal ice cap decayed. There are few deposits of this type in Donegal. Lough Finn is approximately. The site is approximately 3km north of the wind farm. It is designated as a Geological Site of County Importance.

3. Pollnapaste (grid ref. 180000 / 399200). The karst and cave at Pollnapaste / Kilcrum townland is the most extensive and best developed karst in Dalradian Supergroup marbles in Ireland. The site exhibits many features such as speleogenesis controlled by intruded meta-volcanic rocks, tectonic folding and lithological variation in marbles, not seen elsewhere in Ireland. The site is approximately 10km west of the wind farm. It is designated as a Geological Site of County Importance and recommended for NHA designation.
4. Glenaboghill [Zn, Pb] (grid ref. 192300 / 403600). Veins in Dalradian calcareous schists, marble and quartzite. Mined in the early 1800s. The site is approximately 4.5km north of the wind farm. It is designated as a Geological Site of County Importance.
5. Kilrean Appinite (grid ref. 179700 / 392100). Appinite with range of petrological features - part of Ardara appinite suite. The site is approximately 6km southwest of the grid connection point. It is designated as a Geological Site of County Importance and recommended for NHA designation.
6. Kilrean (grid ref. 179700 / 392100). Mineralogy. The site is approximately 6km southwest of the grid connection point. It is designated as a Geological Site of County Importance and recommended for NHA designation.

The closest heritage site to the wind farm is the geological contact at Stralinchy. It is located 2km to the west of the wind farm site and approximately 500m to the south of the grid connection route - see Appendix 6-2 for location maps and GSI site report. Its location is also shown on Figure 6-1 attached below. No element of the wind farm development crosses the geological contact for which Stralinchy is designated, so no direct or indirect impact is envisaged. All the other sites are greater than 3km from the proposed development site and have no direct or indirect connection.

6.2.2. Regional Bedrock Geology

According to the GSI – Geology of South Donegal, the area is underlain largely by the Termon Formation and Slieve Tooey Quartzite Formation. Other formations with lesser areal extent are also present, such as the Cranford Limestone Formation. These formations form part of the Kilmacrenan Succession, itself part of the Knockateen Nappe. These are Precambrian-aged rocks, showing a high degree of metamorphism and complex relationships due their long history of folding, faulting, igneous intrusions and other tectonic activities. The regional bedrock geology is shown on Figure 6-1 below.

6.2.3. Local Bedrock Geology

The rocks found within and immediately adjacent to the site are described in greater detail. The symbol for each formation is given in brackets for cross-reference purposes with the bedrock geology map. These are described from the literature as follows:

Termon Formation (TE) – The Termon Formation is predominantly a banded semi-pelitic and psammitic schist. The formation is calcareous towards its top. There is also interbedding with occasional thin dolomitic marbles and calcareous psammites. This underlies turbines T02, T04, T05, T07, the substation, the met mast and eastern part of the transport route upgrade. It also underlies the eastern end of the grid connection.

Termon Formation – Knockletteragh Member (TEkg) – The Knockletteragh Member of the Termon Formation consists of poorly sorted pebbly grit with clasts principally of quartz veins. This underlies turbines T01, T03 and T06, and the western part of the transport route upgrade.

Cranford Limestone Formation (CR) – The Cranford Limestone Formation consists of quartzite-dolomite breccia, overlain by dolomitic and calcitic marble with graphitic lamina. Its contact with the Slieve Tooey Quartzite Formation is a site of geological heritage / interest.

Slieve Tooey Quartzite Formation (ST) – The Slieve Tooey Quartzite Formation consists of pale to white well-sorted quartzite and ortho-quartzite with feldspathic quartzite, graded pebbly beds and infrequent calcareous horizons and pelitic and semi-pelitic partings. The western 3.5km of the grid connection passes over this formation.

Metadolerite (Md) – These are metamorphosed sills intruded into the Termon and Slieve Tooey Quartzite Formations. The thicker sills have coarse grained gabbroic interiors and preserve some relict igneous minerals and textures. This underlies turbine T08 and sections of the eastern part of the grid connection.

Bedrock outcrop is frequent across the wind farm site. The GSI vulnerability rating of the entire wind farm site as extreme indicates bedrock at or close to ground surface. Along the grid route, the vulnerability is high and moderate indicating depth to bedrock of 3m to 5m, and 5m to 10m, respectively.

6.2.4. Superficial Geology

The superficial geology is also described from the GSI's Geology of South Donegal, from the Soils Association of Ireland and from the GSI's web-mapping. The superficial deposits are largely derived from glaciation, the development of peat post-glaciation and the deposition along river channels. Overburden depth varied greatly; it is deepest in the valleys, shallowing on the mountain slopes, with little or no overburden on the mountain's steeper slopes.

According to the Soils Association of Ireland, there is one soil association found at the site (wind farm, grid connection and transport route upgrade) as follows:

- Blanket peat (high level) of the Mountain and Hill physiographic division. This soil association covers 5.67% of the Country. It is found on high elevations with slopes of 3° to 4°. The soils are acidic (pH of 4 typical) and poorly drained.

The GSI web-mapping shows that the site is covered by four soil / overburden types:

- Blanket bog. This covers the majority of the wind farm, substation, transport route upgrade and the majority of the grid route.
- Bedrock outcrop and subcrop. This is shown as occurring in small patches across the wind farm site.

- Tills derived from metamorphic rocks. These occur primarily in the valley of the Stracashel River and underlies sections of the grid connection route.
- Alluvium. These deposits occur to the west of the site along the river valleys.

Figure 6-2 below is taken from the GSI web-mapping and shows the overburden geology of the area with the locations of the turbines, site roads, substation, grid connection and transport route upgrade shown.

From the walkover of the site, it is found that the GSI website gives the best representation of the soil cover at the site. Much of the site is covered by blanket bog, which has developed in the last 6,000 years. The peat was found to be up to 5.4m deep within the wind farm site but is generally less than 1.0m on the hillside north of the public road. Peat depth to the south of the public road was probed in 2009 and is generally deeper – but there is no development proposed in these areas with deep peat south of the public road.

6.2.5. Hydrogeology

Groundwater is an important resource for drinking water supply, accounting for 25% of water supplies in Ireland. In County Donegal, surface water is the main source of drinking water supplies, but groundwater is becoming more important with deterioration of surface water quality.

On the GSI website, the Termon Formation (and other metamorphic formations) is classified as a poor aquifer, generally unproductive except in local zones (Pl). Figure 6-3 below shows the bedrock aquifers in the area. As shown, the wind farm, grid route and transport route upgrade are underlain by Pl aquifers. Most of the groundwater movement occurs within the upper fractured / weathered zone. Wells in these rock formations yield enough water generally for only domestic supply (0.2 to 0.5litres/sec or 17 to 45m^3/day). Occasionally, in major fracture zones higher yields are achieved, but these yields often decrease in dry weather making supplies unreliable. Yields of greater than 100m^3/day are exceptional.

Because of the low permeability of the peat and rock and the slopes, it is interpreted that most of the rainfall incident on the site will result in surface water runoff. The peat will absorb water when dry, but once saturated, any precipitation will result in runoff or water-lodging. The slopes on the site impose the greatest control of runoff characteristics.

The GSI has rated the aquifer vulnerability as extreme across the wind farm site; at the transport route upgrade and along the grid route it varies from moderate to extreme. Turbines are mostly located in areas with an extreme vulnerability classification; however, the nature of the proposed development doesn't present a significant risk to groundwater quality.

The area is not serviced by mains water or group scheme. Drinking water is sourced from individual bored wells and mountain streams. Wells in the area, identified from the GSI web-mapping and shown on Figure 6-3 below are:

1. Bored well in the townland of Meenavale at grid co-ordinates 189810 / 395500. The well is reportedly 77.7m deep with bedrock encountered at 3.7m. It is used for domestic and agricultural supply with a poor yield of 10.9m^3/day. W1 on Figure 6-3.
2. Bored well in the townland of Banganboy at grid co-ordinates 188880 / 396450. The well is reportedly 32m deep with bedrock encountered at 3.7m. It is used for domestic supply with a poor yield of 6.8m^3/day. W2 on Figure 6-3.
3. Bored well in the townland of Graffy at grid co-ordinates 188540 / 396750. The well is reportedly 32.6m deep with bedrock encountered at 5.7m. Its use is not known, and its yield is not reported. W3 on Figure 6-3.
4. Bored well in the townland of Graffy at grid co-ordinates 188610 / 396790. The well is reportedly 72.6m deep with bedrock encountered at 5.1m. Its use is not known, and its yield is not reported. W4 on Figure 6-3.
5. Bored well in the townland of Graffy at grid co-ordinates 188640 / 396820. The well is reportedly 87.8m deep with bedrock encountered at 4.5m. Its use is not known, and its yield is not reported. W5 on Figure 6-3.
6. Bored well in the townland of Graffy at grid co-ordinates 188660 396860. The well is reportedly 90.5m deep with bedrock encountered at 4.3m. Its use is not known, and its yield is not reported. W6 on Figure 6-3.

7. Bored well in the townland of Meenamalragh at grid co-ordinates 187510 / 396420. The well is reportedly 74.7m deep with bedrock encountered at 4m. It is used for domestic and agricultural supply with a moderate yield of 43.6m^3/day. W7 on Figure 6-3.

One spring source was identified on the wind farm site that services the house located between turbines T02 and T03. This is a shallow dug well where groundwater seepage is collected in a small basin and piped to a header tank. It is shown in Plate 6-1. Its location is marked on Figure 6-3 as W8.

Plate 6-1: Shallow Dug Well – Drinking Water Source W9

Three other wells used for drinking water supply are located at 190447 / 396502 (spring), 190625 / 396517 (roadside spring), 190726 / 396576 (a bored well) and 190726 / 396403 (bored well) – locations are marked on Figure 6-3 as W9, W10, W11 and W12, respectively. These are located in the cluster of houses to the southeast of the substation location. These houses also source water from the adjacent streams for agricultural uses.

6.2.6. Economic Geology

According to the Directory of Active Quarries, Pits and Mines in Ireland, there are no quarries within the vicinity of the site. There is a small disused quarry to the southeast of the wind farm – see P1 in Appendix 6-3. There are several mineral deposits to the north of the site, many along the R250 between Glenties and Fintown and consist of marble, granite, limestone, gravel and a number of metallic ore deposits. The development of the wind farm will have no impact on the exploitation of these deposits.

The site and immediate environs are not listed in the Memoir of Localities of Minerals of Economic Importance. There are historic mines in the wider area including Kilrean, approximately 8km to the west of the site. Lead was mined at this location, and as noted above is a site of geological heritage / interest for its mineralogy.

The GSI online Aggregate Potential Mapping Database shows that the proposed wind farm site is not located within an area mapped as having granular aggregate potential (i.e. potential for gravel reserves). Small pockets along the valleys of the Stracashel Rivers adjacent to the grid route have Very Low potential for granular aggregate. The wind farm site is mapped as having Low to High potential for crushed rock aggregate.

The wind farm, grid route and transport route upgrade are covered by three prospecting licence areas (3070, 3071 and 3072). The licences are not held by any prospecting company and there are no reports – refer to the DCENR website - http://spatial.dcenr.gov.ie/ExplorationAndMining/SpatialViewer/index.html .

6.2.7. Existing Slope Stability

Based on available data from the GSI, there are no records of slope failure within the wind farm site, along the proposed grid route or the proposed transport route upgrade. GSI records indicate that several landslides occurred between 2km and 5km to the south / southeast of the site. The details from the GSI web-mapping are summarised in Table 6-3 and the closest three are shown on Figure 6-2. These landslide incidents are distant from the Graffy site and their occurrence shouldn't be projected onto the site.

Table 6-3: Summary of Landslides in the Area

Location	Co-ordinates	Distance from Site (km)	Description
Croaghahatta	591746 / 895186	2.1 to SE	Peat landslide overlooking Lough Ea – no detail on date, size, trigger etc.
Clogher East	593881 / 895988	2 to SSE	Peat landslide – no detail on date, size, trigger etc.
Clogher East	594053 / 895734	2.2 to SSE	Peat landslide – no detail on date, size, trigger etc.
Lacroagh	593004 / 894255	3.6 to SE	Peat landslide– no detail on date, size, trigger etc.
Croveenanania	593705 / 894123	4.3 to SE	Peat landslide – no detail on date, size, trigger etc.
Croveenanania	593963 / 893 852	4.6 to SE	Peat landslide – no detail on date, size, trigger etc.
Crolack	596649/ 894196	6.8 to SSE	Till landslide – no detail on date, size, trigger etc.

The GSI landslide susceptibility mapping uses eight classifications for landslide susceptibility, ranging from Low to High. Most of the Graffy site is mapped as 'moderately low' to 'moderately high', with some areas classified as 'high'. The areas mapped as 'high' coincide with the steepest slopes (generally upslope of the proposed development) and not necessarily with the occurrence of peat.

Following the site walkover, a review of the potential for a landslide hazard as outlined in Figure 1.1 of the Scottish Executive – Peat Landslide Hazard and Risk Assessments (April 2017) was carried out. Assessment of peat landslide risk is required where:

- Peat is present at the development site.
- There is evidence of current or historical landslide activity of the site, or there is raised bog present or slopes > 2° are present on site.

The site walkover did find evidence of localised peat deposits >0.5 deep on slopes more than 2°. A construction-related peat stability assessment is therefore necessary for the wind farm site and is provided in Section 7.4.3 and includes an assessment of the transport route upgrade at Lughveen.

The grid connection route largely follows public roads and existing forestry roads to the ESB substation at Drumnalough. A short section at the eastern end (near the substation) cuts across a field for approximately 50m. There was no evidence noted of past peat landslide or failure within the corridor of the cable route. Based on the information collected during the site walkover, it is concluded that detailed peat stability assessment is not necessary for the grid connection route. The risk of construction-related peat landslide along the cable route is considered negligible.

6.2.8. Contaminated Land

According to EPA web-mapping, there are no land uses within the wind farm site that could give rise to contaminated land. There were no potential contaminated land sites identified during the site walkovers.

6.2.9. Field Survey Results

A walkover survey of the site and surrounding area was carried out on several occasions between October 2018 and December 2020. Field data was collected at numerous points across the site to provide an overall assessment of ground conditions. The data collected is summarised in Appendix 6-3. In total, peat depth was measured at over 1,700 locations across the site. Ground conditions at the turbines, substation and transport route upgrade are summarised in Table 6-4. Survey positions are shown on Figures 6-5 to 6-11 attached below.

Table 6-4: Summary of Field Data

Turbine No.	Associated Probe No.'s	Peat Depth Range + Average (m)	Comments
T01	P1510 – P1535	0.0 to 1.4; D_{avg} = 0.4; D_{median} = 0.3	T01 is in commercial forestry, mostly on a flattish shelf with crossfalls of 4°. Topography rises along northern perimeter of hardstand with rock outcrop frequent in this area; this area will need rock breaking. Topography drops off sharply to the south of the hardstand. Some area of peat erosion noted to the east of the hardstand. Small pockets of deeper peat to the north of the hardstand. Location is drained by several forestry drains.
T02	P1581 – P1611	0.1 to 1.8; D_{avg} = 0.6; D_{median} = 0.4	T02 is located on a flattish shelf. Ground rises slightly along northern perimeter of the hardstand and turbine foundation with rock outcrop occurring. Large man-made drain to north of location – flows west then south.
T03	P1047 – P1086 + P1641 – P1646 + P1653 – P1657	0.0 to 3.4; D_{avg} = 1.0; D_{median} = 0.5	T03 is located on a flattish shelf sloping at 3° to the east. Topography falls off steeply from the southern perimeter of the hardstand. Rock outcrop occurs along the southern and northern perimeters of the hardstand and peat depth shallows to the western end of the hardstand. Peat has developed between two bedrock ridges.
T04	P243 + P587 – P607 + P1121 – P1127	0.0 to 1.5; D_{avg} = 0.4; D_{median} = 0.3	T04 is in improved grassland in the curtilage of an old farmhouse (now in ruin) with slopes of approximately 3° to the south. Peat is generally thin. There are a few man-made drains running through the location.
T05	P711 – P735 + P1207 – P1227	0.0 to 2.3; D_{avg} = 1.0; D_{median} = 1.0	T05 is located in a flattish area, but with the northern perimeter of the hardstand running into a rocky slope rising sharply over the turbine location; this will require rock breaking. The crossfall through the hardstand is approximately 5°.
T06	P1162 – P1206	0.0 to 2.0; D_{avg} = 0.8; D_{median} = 0.6	T06 is located on a flattish shelf with crossfalls of approximately 2° through the hardstand. Topography rises along northern perimeter of hardstand with rock outcrop frequent in this area; this area will need rock breaking. There are falls also to the east towards an EPA stream. A second EPA stream runs just west of the hardstand. Some cracking of peat is noted on the bank of this stream, with minor bank collapse.
T07	P766 – P794 + P1242 – P1261	0.0 to 3.7; D_{avg} = 0.7; D_{median} = 0.4	T07 is located on a low rocky ridge with the hardstand extending across a narrow peat basin to a steep rocky slope rising from the northern perimeter of the hardstand. The deep peat is trapped between the rocky ridges. The peat basin slopes to the east at <2°.
T8	P829 – P858 + P1735 – P1749	0.0 to 2.5; D_{avg} = 0.6; D_{median} = 0.2	T08 is located at the west end of a shallow peat basin contained by rocky ridges on the western, northern and southern sides. The peat is drained and appears to have been worked by hand with low turf banks present. The basin is drained by a few man-made drains. Rock breaking for the turbine foundation and northern perimeter of the hardstand will be required.
Substation	P859 – P890 + P1335 – P1360 + P1750 – P1773	0.0 to 3.6; D_{avg} = 1.0; D_{median} = 0.6	The substation is located on improved grassland. The deeper peat is found to the northeast of the substation footprint. This deep peat extends east to the south of the public road along the river valleys. Topography drops off sharply south of the substation footprint.
Transport Route	P1264 - P1303	0.0 to 1.7; D_{avg} = 0.7; D_{median} = 0.7	This route goes through mostly commercial forestry, with a section of improved grassland in the central part of the road section. The route follows the contour from the public road to the east before turning north and descending to the existing Coillte road.

Notes:

1. Peat Depth range refers to depth probed across footprint of foundation and hardstand area and along the alignment of the transport route upgrade.

From the findings of the walkover and site surveys, the site can be divided broadly into 2 areas as follows:

1. Rough terrain with frequent rock outcrop, thin peat cover and variable slope.
2. Flattish areas between rocky slopes with deeper peat development. These occur as isolated peat basins on plateaus and flat shelves between rock ridges.

The turbines are located in areas of varying peat depths, generally less than 1m, but up to 3.7m. The deep peat is found to have developed in narrow basins between rock ridges.

The un-drained shear strength (the maximum shear resistance that soil can offer) of the peat was measured across the development area. Measurements of shear strength recorded within the development area are summarised in Table 6-5. Measurements recorded in 2009 are included in Appendix 6-3, but not summarised in Table 6-5 as they were recorded in areas now outside the development area.

Table 6-5: Summary of Un-Drained Shear Strength Measurements – Peat

Probe ID	Peat Depth (m)	Un-Dra inedShear Strength (kPa)				
		0.5m	1 0m	1 .5m	2.0m	2.5m
P253	1.3	---	12	---	---	---
P374	0.6	64	---	---	---	---
P376	0.7	40	---	---	---	---
P385	0.9	76	---	---	---	---
P398	0.7	15	---	---	---	---
P406	1.8	---	17	---	---	---
P896	1.0	---	28	---	---	---
P915	1.1	---	29	---	---	---
P925	2.0	---	10	11	---	---
P950	0.7	15	---	---	---	---
P975	1.6	---	16	20	---	---
P1017	0.7	15	---	---	---	---
P1030	1.2	---	28	---	---	---
P1032	1.2	---	22	---	---	---
P1036	1.6	---	23	27	---	---
P1040	1.5	---	19	---	---	---
P1048	2.0	---	13	16	---	---
P1053	1.9	---	10	13	---	---
P1077	3.4	---	16	18	18	---
P1125	1.2	---	20	---	---	---
P1157	2.1	---	14	10	---	---
P1177	1.9	---	27	30	---	---
P1186	1.3	---	20	---	---	---
P1202	1.5	---	20	---	---	---

Probe ID	Peat Depth (m)	Un-Drained Shear Strength (kPa)				
		0.5m	1.0m	1.5m	2.0m	2.5m
P1206	1.4	27	60	---	---	---
P1212	1.6	---	20	20	---	---
P1243	3.1	---	18	17	18	17
P1268	1.2	---	50	---	---	---
P1274	1.7	---	25	35	---	---
P1278	1.5	---	24	---	---	---
P1355	2.9	---	13	25	25	---
P1452	0.5	12	---	---	---	---
P1481	1.1	16	24	---	---	---
P1483	1.1	31	22	---	---	---
P1491	1.4	20	19	---	---	---
P1519	1.4	9	11	---	---	---
P1525	0.5	18	---	---	---	---
P1593	1.8	13	11	15	---	---
P1599	15	---	---	---	---	---
P1643	1.1	17	28	---	---	---
P1686	1.5	20	30	---	---	---
P1753	0.6	40	---	---	---	---
P1763	1.8	20	36	---	---	---
P1765	1.6	35	23	28	---	---

The strength of the peat within the development area ranged from 9kPa to 76kPa. These values have been corrected for friction. The average value is 23kPa and the median is 20kPa. To put these values in context, the shear strength of firm clay would be approximately 75kPa. The state of decomposition of the peat was found to be similar across the site (i.e. a Von Post value of 4 / 5 to 6 / 7, depending on depth).

Unconfined compressive strength of the bedrock was taken at several rock outcrops across the site. These measurements indicate that the rock is strong to extremely strong. The strongest rock was found to be the metadolerite, which is found throughout the site as small to medium-sized intrusions into the country rock, for example near turbine T08.

6.2.10. Importance of Soils, Geology & Hydrogeology Attributes

Based on the NRA Guidelines, the importance of the site in terms of soils and geology is rated as low. The soil quality is poor; there are no pits or quarries at the site and the potential for developing same is low; there is no soil contamination identified and given the historic land use, the potential of encountering soil contamination is low; and there are no landfills on the site. While there are geological heritage sites in the wider area, the proposed development will have no impact on them.

Similarly, the importance of the site in terms of hydrogeology is rated as low. The aquifer is rated as poor and wells can generally only supply enough water of individual houses; there are no source protection zones for wells / groundwater.

6.3. Characteristic of the Proposal

The main characteristics of the proposed development that could impact on soils, geology and hydrogeology are:

1. Pre-construction site investigation works. To inform detail design of the turbine foundations, roads, cabling etc, ground investigations will need to be undertaken. Some of these works will be intrusive investigation such as trial pit excavation and drilling. These works will expose soil to erosion from rainfall with potential to impact surface water quality.
2. Construction of access roads and transport route upgrade, which will involve the excavation of rock and soil / peat, and the disposal / reuse of spoil. Conventional road construction will reuse suitable material excavated in the road construction. A dedicated on-site borrow pit is not proposed; it is envisaged that sufficient rock can be won where the road alignment passes over bedrock ridges which need to be cut to achieve vertical gradients. The importation of rock from local quarries will also be required. Deep peat has been avoided based on the probing carried out, so floating roads are unlikely to be needed, however, to reduce the volume of peat excavated, floating roads may be used. The transport route upgrade will include the construction on a new section of forestry road and the widening and strengthening of existing local roads.
3. Construction of hardstand areas and turbine assemblage areas, which will also involve the excavation of rock and peat, and disposal /reuse of spoil. This too will involve the reuse of rock won during the excavation works. Cranage areas are not generally floated on peat as the crane stability is critical during lifts. The assembly areas may be floated to reduce the volumes of peat excavation.

4. Excavation for turbine foundations. For the size of turbine proposed, foundation excavations will be approximately 25m across and approximately 3m deep. Excavated soil and rock will be reused as ballast on the foundation and peat will be reused in landscaping.
5. Construction of turbine and met mast foundations, which will require large volumes of concrete (500m^3 per turbine typical and 100m^3 for the met mast, subject to detail design), placing demand on local concrete batching plants / quarries. Piled foundations are unlikely to be required at this wind farm site.
6. Cabling between turbines and to the on-site substation, which will involve the excavation of trenches approximately 1.3m deep. These will generally follow road alignment, but not in all cases. Internal cabling on the wind farm will reuse excavated material as backfill.
7. Construction of the on-site substation, associated parking area and construction compound, which will involve the excavation of peat and overburden and the use of large volumes of concrete and aggregate.
8. Construction of some roads and turbines require felling of commercial forestry. This will involve introduction of heavy machinery to fell and remove the timber. This work could potentially lead to soil compaction and erosion. This construction felling area will not be replanted. An alternative, remote, replacement area will be replanted subject to Forestry Service approval.
9. Construction of the grid connection to the Drumnalough substation. This will require excavation of a trench over a length of approximately 7.3km. This will also include the use of concrete and aggregate in its construction and the disposal of excavated material that has no on-site reuse potential.

6.4. Potential Impacts of the Proposal

6.4.1. Impact Assessment Methodology

The criteria in the EPA (2017) draft Guidelines are used to evaluate and describe the potential impacts. These are set out in Table 6-6.

Table 6-6: Description of Potential Effects

Quality of Effects It is important to inform the non-specialist reader whether an effect is positive, negative or neutral	**Positive Effects** A change which improves the quality of the environment (for example, by increasing species diversity; or the improving reproductive capacity of an ecosystem, or by removing nuisances or improving amenities).
	Neutral 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 which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health or property or by causing nuisance).
Describing the Significance of Effects ''Significance' is a concept that can have different meanings for different topics – in the absence of specific definitions for different topics the following definitions may be useful (also see *Determining Significance* below.).	**Imperceptible** An effect capable of measurement but without significant consequences.
	Not significant An effect which causes noticeable2 changes in the character of the environment but without significant consequences.
	Slight Effects An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
	Moderate Effects An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
	Significant Effects An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
	Very Significant An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
	Profound Effects An effect which obliterates sensitive characteristics.
Describing the Extent and Context of Effects Context can affect the perception of significance. It is important to establish if the effect is unique or, perhaps, commonly or increasingly experienced	**Extent** Describe the size of the area, the number of sites, and the proportion of a population affected by an effect.
	Context Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?).
Describing the Probability of Effects Descriptions of effects should establish how	**Likely Effects** The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented.

likely it is that the predicted effects will occur – so that the CA can take a view of the balance of risk over advantage when making a decision.	**Unlikely Effects** The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented.
Describing the Duration and Frequency of Effects 'Duration' is a concept that can have different meanings for different topics – in the absence of specific definitions for different topics the following definitions may be useful.	**Momentary Effects** Effects lasting from seconds to minutes.
	Brief Effects Effects lasting less than a day.
	Temporary Effects Effects lasting less than a year.
	Short-term Effects Effects lasting one to seven years.
	Medium-term Effects Effects lasting seven to fifteen years.
	Long-term Effects Effects lasting fifteen to sixty years.
	Permanent Effects Effects lasting over sixty years.
	Reversible Effects Effects that can be undone, for example through remediation or restoration.
	Frequency of Effects Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually).

The following sections detail the potential impacts, prior to mitigation, which have been identified from the assessment methodology presented above.

6.4.2. Do Nothing Scenario

In the 'do-nothing' scenario, the site will continue to be used for low intensity grazing and forestry rotation. Impacts associated with soils and geology from those land uses would potentially be construction of forestry roads to facilitate harvesting, importation of aggregate for forestry road construction, soil erosion and compaction associated with planting and felling activities.

6.4.3. Pre-Construction Site Investigations

Ground investigation will need to be carried out to inform detail design of turbine foundations, substation foundations, road design, HDD techniques etc. Ground investigation will typically take the form of trial pit excavation, drilling and perhaps geophysical survey. From experience at other wind farm developments in similar terrain, trial pit excavations will be the main method, as rock is shallow. Drilling at HDD locations are likely to be undertaken. The potential impacts to soils / geology associated with ground investigation works are:

- Accessing ground investigation locations with track-mounted excavator or drilling rig. The machines will cause compaction to peat / soils along the access route which if unmitigated would result in direct momentary to brief imperceptible negative impact on peat / soils.
- The use of hydrocarbons would present a risk of soil contamination if spills or leaks occurred. Considering the small volumes involved, unmitigated, this presents a localised direct temporary not significant negative impact.
- Excavation of trial pits and drilling will expose excavated soils to erosion from rain. Unmitigated, soil erosion presents a direct brief-temporary imperceptible negative impact.

6.4.4. Construction Phase

The potential impacts of the proposed development on soils, geology, hydrogeology and slope stability during the construction phase are discussed below.

Peat Stability

Slope stability during wind farm construction was highlighted following a bog burst at the Derrybrien wind farm in County Galway in 2003, later in the Stack's Mountains near Tralee County Kerry and Drumkeeran County Leitrim and more recently at Meenbog Wind Farm County Donegal. As many wind farms are proposed in upland areas, typically with blanket bog, the assessment of slope stability has become an important factor in the siting and design of wind farms; peat landslides can have medium term profound negative impacts on the environment.

Peat and/or subsoil on sloping ground can become unstable when the gravity forces acting on the soil mass exceed the shear strength of the material. This failure can occur as landslides or flows. Slides are distinguished from flows in that slides are the movement of large continuous masses of soil/peat along a slip surface. Flows are the movement of material softened and lubricated by water, such as bog bursts. Slip planes are less evident in the latter.

The factors that could influence the failure of slopes during the construction of a wind farms include:

1. Nature of peat; very wet, degraded blanket bog or excessively worked / harvested with machinery such as 'sausage cutter'. Only hand cutting (mostly historic) was observed within the development footprint. Turf cutting is more prevalent to the south of the wind farm site where deeper peat has developed.
2. Interference with site drainage, resulting in changes in the hydrological regime of the peat. The drainage of the site is already altered considerably. There is commercial forestry in the central part of the site (between T04 and T05) and at turbine T01 with a network of man-made drains. There are also many shallow man-made drains across the site installed to drain the rough grazing lands in which the other turbines are proposed.
3. Stockpiling of material on peat, creating loads in excess of bearing capacities. This could include imposition of floating roads on weak peat. There is only a thin veneer of peat within most of the development footprint and floating roads are unlikely to be used at the site.
4. Inappropriate disposal of water from dewatering operations. With the relatively shallow depth of excavations required for turbine foundations, dewatering of foundation excavations is not envisaged.
5. Excavation of roads though areas of weak peat thus removing support for the upslope peat. Peat is thin through the development area and the bedrock surface is undulating, so where peat is deeper, it is contained between rock ridges.
6. Triggering events such as traffic movements (or blasting for breaking out of rock). Blasting is unlikely to be required during construction of the wind farm. If required, micro-blasting would be used.

There have been 2 documented bog bursts in County Donegal, according to the Bogs of Ireland, which documents 38 occurrences throughout the Country. These occurred at Meenacharvy and Meenaneary, Glen Valley to the northwest of Killybegs (in January 1945) and Barnsmore (in November 1963). More recently, the GSI has published a report on landslides in Ireland. This report documents one further landslide in County Donegal. This occurred in Donegal Town in 1999 – details are not provided, but it appears to be related to the construction of the Donegal by-pass. In the GSI web-mapping, several other bog slides are documented. The ones nearest the site are listed in Section 6.2.7 (Table 6-3).

Bog bursts / landslides are naturally occurring events and can occur without any anthropogenic influence. In blanket bogs, they tend to be more frequent in areas with high rainfall, occurring at times of the year when rainfall is highest (autumn and winter months). Analysis of the occurrence of landslides in Ireland between 2003 and 2010 indicates at least two causal factors – intense rainfall and human activity (such as turf cutting and road construction)[1]. For example, intense rainfall in August 2018 caused a landslide on the steep slopes on the mountains east of Buncrana without human interference (see Plate 6-2), while the peat landslide at Ballincollig Hill near Tralee in 2008 is associated with intense rainfall during wind farm road construction (floating road) on blanket bog extensively worked by sausage cutter (see Plate 6-2).

Plate 6-2: Landslide at Eskaheen Mt., Buncrana & Ballincollig Hill, Tralee

(note sausage cutting at Ballincollig Hill site)

The causes of naturally occurring bog bursts have been attributed to prolonged periods of drought followed by heavy rainfall events; the drought causing drying and cracking of the peat, followed by the influx of large volumes of water. The water weakens, increases pore water pressures and lubricates the peat causing it to liquefy. This is believed to have been the cause of the peat landslide in Leitrim in June 2020. Another

[1] Long, M, Jennings, P. and Carroll, R. 2011. *Irish Peat Slide 2006 – 2010.* Earth and Environmental Science – Landslides, Springer Publications on-line.

cause is attributed to the blockage or restriction of underground streams (pipe-flows), resulting in the build-up of water within the peat. The bog bursts have been recorded on shallow slopes as low as 2°.

Natural triggering events could include earthquakes. The Irish National Seismic Network (https://www.insn.ie/) operates several seismic monitoring stations in an expanding network around Ireland. The British Geological Survey also monitors and reports on seismic activity. Earthquakes have been recorded in recent years in Ireland; the most recent occurred in February 2020 with a magnitude of 0.92. There are multiple earthquakes recorded in Ireland each year, but with low magnitudes, typically less than 2.5. The largest recorded event occurred off the coast of Wales on 19 July 1984, measuring 5.4 on the Richter Scale, and was felt on the east coast of Ireland and the Midlands.

The most recent construction-related peat landslide occurred during the construction of the Meenbog Wind Farm, County Donegal on 12 November 2020. A review of the publicly available information is provided to assist in the understand of the triggering events, the ground conditions that are susceptible to peat slippage and how these compare to the Graffy site. Plate 6-3 illustrates the location of peat slippage and works being undertaken.

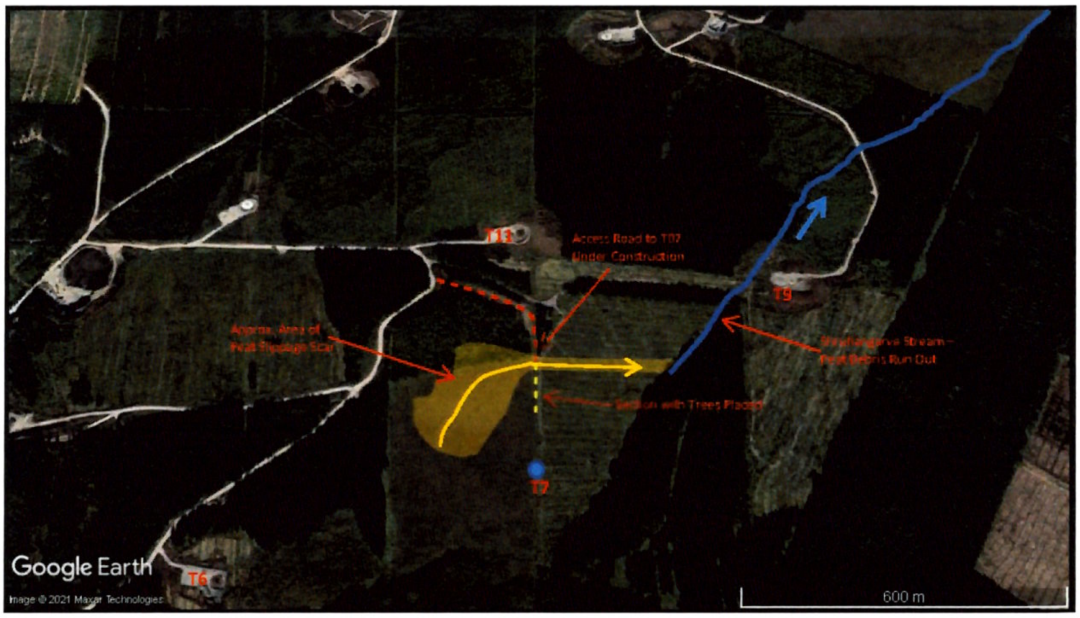


Plate 6-3: Aerial View of Meenbog Peat Slippage

The slippage occurred during the construction of a floating road to turbine T07. The works were progressing from north to south. The floating road consisted of forestry brash and felled trees laid on the bog surface; a layer of geogrid/geomembrane rolled out across the trees followed by the placement of engineered fill / aggregate. The placement of brash and trees was approximately 100m ahead of the placement of aggregate. It is reported that during the placement of aggregate, peat movement was observed beneath the road by the machine operators.

Peat movement was initiated, possibly by the static loading from trees (forming the base of the floating road), but more likely from dynamic loading from machinery movement on the logs and perhaps by the discharging of aggregate from lorries. The failure propagated upslope and fanned out as support for peat was progressively removed.

The ground conditions at the failure site were:

1. The floating road to T07 followed a convex break-in-slope, roughly following the 260mOD contour. The upgradient slope was approximately 1°, while the down gradient slope was approximately 4°. The upslope area formed a plateau with deep soft wet peat, which extends up to an area of approximately 15ha. The unplanted areas extend to approximately 9.5ha. Approximately 3ha of this area was affected by the slippage, with up to 75,000m^3 of peat mobilised.

2. Peat depths were in the range of 2.5m to 3.5m where the failure occurred, and peat thicknesses of up to 4m upslope near the road to T06. The failure propagated into the flat area towards this area of known deeper peat. The flat basin was not probed during EIAR, but peat depth is likely to have been in the 4m range.

3. The in-situ shear strength of the peat as measured pre-construction ranged from 7kPa to 12kPa.

The area was in commercial forestry or was drained for planting. The area into which most of the failure propagated was not planted – see Plate 6.3. While it is not known why this area wasn't planted, it is often because the ground conditions are wet, soft deep peat and unsuitable for tree growth.

The ground conditions found at the Meenbog Wind Farm peat slippage site do not occur within or near the development footprint of the Graffy Wind Farm site.

- Extensive areas of deep peat do not occur at the Graffy development as they do at Meenbog. As noted above, a floating road was being constructed across an area of deep peat which extends upslope for up to approximately 15ha. Deep peat occurring at Graffy occurs in small, isolated areas, contained, and trapped by bedrock ridges. One area where uncontained deep peat occurs was avoided by relocating turbine T06 – refer to Figure 6-8. Areas of deep peat to the south of the public road at Graffy are also avoided. As such, peat slippage that occurred at Meenbog in terms of size, extent and negative effects of the environment can't occur at the Graffy site.

- The use of floating roads is not proposed for the Graffy site. Floating roads are not required as the areas of deeper peat have been avoided in the road layout design. It is the works associated with the construction of a floating road across deep peat that triggered the peat failure at Meenbog. It is noted that the volume of peat to be excavated for the construction of Meenbog Wind Farm was estimated to be 247,075m^3, including a 25% bulking factor, but also includes the proposed mitigation of using floating roads to reduce peat excavation volumes. This averages 13,004m^3 per turbine. For the Graffy site, the total volume of peat to be excavated is estimated at 48,048m^3 (or 60,060m^3 with a 25% bulking applied, which is considered unnecessary for peat), or approximately 7,508m^3 per turbine.

Peat Slide Risk Assessment

The GSI report on landslides in Ireland represents a case study for the landslide susceptibility in County Mayo. This is a desk-based assessment using data on the land cover, soil type and slope. The study used the following parameters to identify areas susceptible to landslide:

- Peat cover
- Slopes greater than 15° (1V:3.73H)

The study was extended across the County to provide an indication of landslide susceptibility based on slope and soil cover – see GSI web-mapping. Eight classifications for landslide susceptibility are mapped, ranging from Low to High. Most of the Graffy site is mapped as 'moderately low' to 'moderately high', with some areas classified as 'high'. The areas mapped as 'high' coincide with the steepest slopes and not necessarily with the occurrence of peat. It should be noted that the landslide susceptibility classifications combine several factors including material type, slope / topography and historical occurrence of landslides. Therefore, a rating of 'moderately high' would typically be assigned where rock is close to the surface and slope angles range from 10 to 20°. Hence the rating of 'moderately high' does not necessarily relate to the risk of peat landslide.

There are deep peat deposits at the site, but slopes are generally <2° where these occur, the peat cover is thinnest on the steeper slopes, which range up to approximately 15°. The Wind Farm Planning Guidelines (Appendix 4 – Best Practice for Wind Energy Development in Peatlands) requires that a geotechnical and landslide risk assessment '*is be carried out where depth of peat is in excess of 50cm*'. A peat landslide risk assessment is therefore required for the Graffy site.

The Scottish Executive Guideline[2] on peat landslide hazard and risk assessment is used to provide a qualitative risk assessment using judgement and semi-quantitative rating scales. The risk assessment process is presented here for thin to moderately deep peat cover on glacial tills and /or rock.

The guide uses the concept of risk analysis for a particular hazard as follows:

Risk = Probability of Peat Landslide x Adverse Consequences

Degree of Risk = Likelihood x Effect

Hazard Ranking = Hazard x Exposure

where: Hazard = likelihood of the landslide event occurring.

Exposure = the impact and consequences that the event may have.

[2] Scottish Executive, April 2017. *Peat Landslide Hazard and Risk Assessment – Best Practise Guide for Proposed Electricity Generation Developments – 2nd Edition*

Adverse Consequences = accidents, loss of life, adverse environmental impacts or damage to site infrastructure.

Table 6-7: Qualitative Assessment of Landslide Hazard

Scale	Likelihood	Probability of Occurrence
5	Almost Certain	> 1 in 3
4	Probable	1 in 10 to 1 in 3
3	Likely	1 in 10^2 to 1 in 10
2	Unlikely	1 in 10^7 to 1 in 10^2
1	Negligible	< 1 in 10^7

There are several approaches to estimate the probability of peat landslide occurrence. These include historical frequency of occurrence, probability of landslide triggering events, expert judgement and stability analysis. For the purposes of assigning a likelihood of a construction-related peat landslide, the site has been divided into two broad zones. A factor of safety (FOS) is calculated for each zone using site specific worst-case measurements, including slope, peat depth, bulk unit weight for peat and un-drained shear strength of the peat. FOS values are not calculated at discrete locations across the site, rather the parameters representing worse-case conditions were used to characterise the two zones. So, at any discrete location, the FOS would be higher than the value used to represent that area. Factor of Safety = Shear Resistance / Shear Force

- Zone 1 – Areas of the hillside with steeper slopes but with thin peat. Peat depth is generally less than 0.5m but up to 1m. Slopes are variable, but up to ~15° on the steeper sections of the hillside. The average slope of the hillside from the highest turbine (T02) to the public road is 7°. Taking a worst-case scenario of 1.5m peat on a 15° slope with a bulk unit weight of 10.3kN/m^3 and a shear strength of 9kPa (lowest recorded shear strength value), the factor of safety in Zone 1 = 2.33.
- Zone 2 – Areas with deeper peat which occur as small, isolated basins within the development area. Peat depth is typically <3m, but has been probed to 3.7m. Slopes are generally 2 to 3°. Taking a worst-case scenario of 3.9m peat on a 4° slope with a bulk unit weight of 10.3kN/m^3 and a shear strength of 9kPa (lowest recorded shear strength value), the factor of safety in Zone 2 = 3.22. These areas

are shown coloured (= 1.5m to 2m; = 2m to 3m; and = >3m) on Figures 6-5 to 6-9.

FOS values greater than 1.3 are considered stable. It is important to recognise that the situations above do not occur on the site; it represents a combination of factors that would give rise to a worst-case situation. For example, on steeper slopes of 15°, the peat is less than 0.5m and the undrained shear strength is greater than 30kPa – FOS = 23.3.

Table 6-8 outlines the contributing factors and hazard scoring system based on the Scottish Forestry Commission guidelines and Table 6-9 summarises how these scores translate to the likelihood of a hazard occurring.

Table 6-8: Landslide Hazard Probability Assessment Matrix

Contributing Factor	Method of Assessment	Value/Indicator	Probability of contributing to peatmovement	Hazard Score
Moisture Content of Peat	Visual (Von Post Scale)	B1 (dry)	Negligible	1
		B2 (damp)	Unlikely	2
		B3 (moist)	Probable	3
		B4 (wet)	Likely	4
		B5 (very wet)	Very likely	5
Degree of Humification	Visual (Von Post Scale)	H1-H2 (fibrous, clear water)	Negligible	1
		H3-H4 (fibrous, brownwater)	Unlikely	2
		H5-H6 (pseudo-fibrous)	Probable	3
		H7-H8 (amorphous,some fibres)	Likely	4
		H9-H10 (amorphous paste)	Very likely	5
Peat Depth	Peat probes and Trial Pits	0 - 0.5m	Negligible	1
		0.6- 1.0m	Unlikely	2
		1.1 - 1.5m	Probable	3
		1.6 - 2.0m	Likely	4
		> 2.0m	Very likely	5
Peat Strength (corrected)	Hand Vane Tests	>20 kPa	Negligible	1
		16 - 20 kPa	Unlikely	2
		11 - 15 kPa	Probable	3
		6 - 10 kPa	Likely	4
		0 - 5 kPa	Very likely	5
Slope Angle	Measured from contours	0 to 3	Negligible	1
		4 to 9	Unlikely	2
		10 to 15	Probable	3
		16 to 20	Likely	4
		20 +	Very likely	5
Cracking or evidence of slips	Visual	None evident	Negligible	1
		Few	Unlikely	2
		Frequent	Probable	3
		Many	Likely	4
		Continuous /significant	Very likely	5
Local Hydrology	Visual	None evident	Negligible	1
		Few	Unlikely	2

Contributing Factor	Method of Assessment	Value/Indicator	Probability of contributing to peat movement	Hazard Score
(gulleys, channels hags, pools, flushes, water courses)		Frequent	Probable	3
		Many	Likely	4
		Continuous/significant	Very likely	5
Weather	Weather Records	Previous very dry period in excess of 5yrs	Negligible	1
		Previous very dry period within 4 - 5yrs	Unlikely	2
		Previous very dry period within 3 - 4yrs	Probable	3
		Previous very dry period within 2 - 3yrs	Likely	4
		Previous very dry period within 1 - 2yrs	Very likely	5

Table 6-9 summarises how the scoring detailed in Table 6-8 translate to the likelihood of a hazard occurring.

Table 6-9: Likelihood of Hazard Occurring

Combined Hazard Score	Probability	Scale
33 to 40	Almost Certain	5
28 to 32	Probable	4
23 to 27	Likely	3
18 to 22	Unlikely	2
8 to 17	Negligible	1

Table 6-10 summarises the scores assigned for each of the zones mapped at the Graffy site.

Table 6-10: Landslide Hazard Probability Ranking – Graffy Site

Factor	Zone1	Zone 2	Transport Route Upgrade
Moisture Content of Peat	2	4	3
Degree of Humification	2	3	3
Peat Deph	2	5	3
Peat Strength	2	3	2
Slope Ange	4	1	2
Cracking or evidence of slips	2	1	1
Local Hydrology (gulleys, channels, hags, pools, flushes, water courses, blocked drains)	3	2	2
Weather	3	3	3
Total Score	20	22	19

The likelihood of a construction-related landslide in:

- Zones 1 and 2 and the transport route upgrade is considered 'Unlikely'.

Having estimated the likelihood of a construction-related peat landslide occurring, the adverse consequences are then evaluated. Adverse consequences could include harm to construction workers, damage to infrastructure, damage to neighbouring property, economic loss, environmental impact etc.

Table 6-11: Degree of Adverse Consequences for Landslide Exposure

Scale	Adverse Consequences	Impact as % Damage to (Loss of) Receptor
5	Extremely High Impact	>100% of Asset (infrastructure or Habitat)
4	Very High Impact	10% to 100% of Asset
3	High Impact	4% to 10% of Asset
2	Low Impact	1% to 4% of Asset
1	Very Low Impact	<1% of Asset

The exposure of the site to landslide in terms of project cost is estimated as very low impact. The project cost is estimated at €1.7M per megawatt (MW). With 8 turbines of 4.5MW, the total project cost is estimated at ~€61.2M. The cost of impact for a landslide clean-up would be <1% of project cost (i.e. <€600k). This budget estimate is based on the nature of peat, generally shallow depth of peat, confinement of the deeper peat where it occurs by rock ridges, etc.

In terms of environmental impact, the wind farm is adjacent to the upstream section of the River Finn SAC and upstream of the West of Ardara/Maas Road SAC. The streams draining the site feed into these SACs. Based on the nature of the peat (depth, confinement by rock ridges etc), the impact to the SACs would be very low impact – i.e. <1% (i.e. <55ha of the Finn River SAC (5,498ha) and <67ha of the West of Ardara/Maas Road SAC (6,733ha)) would be impacted. Extensive areas (10s of hectares) of deep peat (>2m), typical at sites where construction-related peat landslides occur, are not present at the Graffy site. The ground conditions within the development footprint of the Graffy site differ significantly from those encountered at the sites where construction-related peat landslides have occurred. As shown in Figures 6-5 to 6-9, areas of peat depth greater than 1.5m are small within the site.

The risk levels are produced by combining the qualitative descriptors for likelihood and adverse consequences. These are shown in Table 6-12.

Table 6-12: Indicative Risk Levels

		Adverse Consequence				
		Extremely High	**High**	**Moderate**	**Low**	**Very Low**
Peat Landslide Probability or Likelihood	Almost Certain	High	High	Moderate	Moderate	Low
	Probable	High	Moderate	Moderate	Low	Negligible
	Likely	Moderate	Moderate	Low	Low	Negligible
	Unlikely	Low	Low	Low	Negligible	Negligible
	Negligible	Low	Negligible	Negligible	Negligible	Negligible

The indicative risk level for the two wind farm zones and the transport route upgrade is negligible. The suggested actions for the various risk rankings are summarised in Table 6-13. The action suggested for this project risk ranking is the '*Project should proceed with monitoring and mitigation of peat landslide hazards at these locations as appropriate*'. The site layout and construction methods has been refined to avoid the areas within the site which drive the probability score for Zone 2. These are discussed below as part of the mitigation measures for the site and have regard to the sensitive nature of the receptors downstream of the wind farm and transport route upgrade – i.e. the SACs in the two river catchments and the habitats and fauna they support.

Table 6-13: Risk Ranking and Suggested Actions

Risk Level	Action Suggested for Each Hazard Zone
High	Avoid project development at these locations
Medium	Project should not proceed unless hazard can be avoided or mitigated at these locations, without significant environmental impact, in order to reduce hazard ranking to significant or less
Low	Project may proceed pending further investigation to refine assessment and mitigate
Negligible	Project should proceed with monitoring and mitigation of peat landslide hazards at these locations as appropriate

The overall conclusion is that a peat landslide occurring is unlikely and the indicative risk level is negligible. A comprehensive set of avoidance, reduction and mitigation measures are proposed as set out in Section 6.5. This includes avoidance of conditions that triggered peat slippage at Meenbog, namely the loading of weak peat by use of floating roads or stockpiling of excavated material.

Rock Stability

In addition to peat/soil failures, rock slopes can also be unstable or made unstable due to construction works. The erosion and failure of rock slopes is a natural process. Failure of rock slopes generally occur following a triggering event, along planes of discontinuity or weakness. Stability issues are a particular concern in limestone regions where subsidence may occur due to the presence of karst features. While the Cranford Limestone Formation occurs near the site, there are no karst features associated with it and there is no infrastructure proposed over the Cranford Limestone Formation.

Rockslides generally occur along bedding planes, joints, cleavage or faults which are inclined toward the slope (i.e. their lower surface is exposed). There are many types of failure mechanisms, such as planar slide, wedge failure, rotations, rock topple, rock falls etc. Triggering events include a rise in groundwater level (water can provide buoyancy and can also lubricate joints in bedrock), toe removal (i.e. undercutting of slope), head loading (e.g. turbine too close to edge of rock slope, or stockpiling of material too close to the rock edge), and vibration (e.g. earthquake, blasting or rock breaking).

There are steep rocky slopes at the site at which rock falls and toppling may occur, although the risk is low. The excavation of rock cuts for roads and cranage areas will increase rock slopes locally, which may increase the potential for rock falls along these cuts. Mitigation measures to address these risks are provided in Section 7.5.

Geological Heritage

There is one geological heritage site near the proposed development site. Its location is shown on Figure 6-1. It is located approximately 500m to the south of the grid connection route. The interest in this location is an unconformable geological contact between Precambrian rock formations; it is the only known location exposing this contact in the world. Previously, the GSI was consulted on this matter and have recommended that prior to construction, the exact location of the geological contact be mapped and marked in the field and a 20m buffer to the main areas of the exposure provided. Any data collected from site investigation during detail design should be provided to the GSI. However, as discussed in Section 7.2.1, there are no works proposed over the geological contact for which this heritage site is designated so no direct or indirect impacts will occur.

Road & Foundation Construction

The access roads serving the wind farm will be constructed using conventional road construction methods; floating roads are not envisaged based on probe data along the routes. There will be approximately 4.5km of new road constructed at the wind farm and 670m of new road constructed for the transport route. There will be four entrances to the wind farm from the public road, so to an extent, use of the public road reduces the requirement for new road construction (i.e. between turbines T02 and T03, and between turbines T07 and T08). An estimate of the peat volumes associated with road construction is provided in Table 6-14. Note that the volumes presented assume that all roads are constructed using conventional road construction (i.e. roads founded on till subsoils or rock).

Table 6-14: Summary of Peat Spoil – Road Construction

Road Section	Length (m)	Road Footprint Area (m^2)	Peat Depth$_{avg}$ (m)	Peat Vol (m^3)
Site Entrance to T01/T02 Junction	310	2,181	0.4	872
T01/T02 Junction to T01	485	4,497	0.6	2,698
T01/T02 Junction to T02	600	7,959	0.3	2,388

Road Section	Length (m)	Road Footprint Area (m^2)	Peat Depth$_{avg}$ (m)	Peat Vol (m^3)
Site Entrance to T03/T04 Junction	300	1,830	0.4	732
T03/T04 Junction to T03	837	4,036	0.5	2,018
T03/T04 Junction to T04	235	1,714	0.5	857
T04 to T05/T06 Junction	256	1,809	0.8	1,447
T05/T06 Junction to T06	391	3,425	0.5	1,713
T06 Hammerhead	35	441	0.5	221
T05/T06 Junction to T05	208	1,259	1.2	1,511
T05 to T07	545	5,393	0.7	3,775
T07 Hammerhead	132	1,818	0.4	727
Site Entrance to T08	278	2,120	0.4	848
Site Entrance to Substation	140	1,336	0.2	267
Transport Route Upgrade	670	4,020	0.7	2,814
TOTAL	**---**	**---**	**---**	**22,888**

For the conventional road construction, unsuitable material will need to be removed. This will include at a minimum the peat. Peat turves (acrotelm) catotelmic peat will be carefully placed separately to one side of the road for reuse in roadside restoration. Excess catotelmic peat will be taken to the nearest peat restoration area. Rock will then be used as a base course for the road followed by a crushed rock wearing course. For floating roads, a geotextile / geogrid layer(s) would be placed directly onto the ground surface and a layer of coarse rock placed as a base course followed by a crushed rock wearing course.

Sections of the public road will be strengthened and widened to facilitate delivery of over-sized loads. Where widening is needed, it will be done on the upslope side of the road. This work will include removal of vegetation and soft soil; relocating drainage upslope; placement of geogrid into the area to be widened and overlapping onto the existing road; and placement of stone. Any soils removed will be reused for landscaping and restoration of the road verge; no excess peat is envisaged. This is illustrated on Plate 6-4.

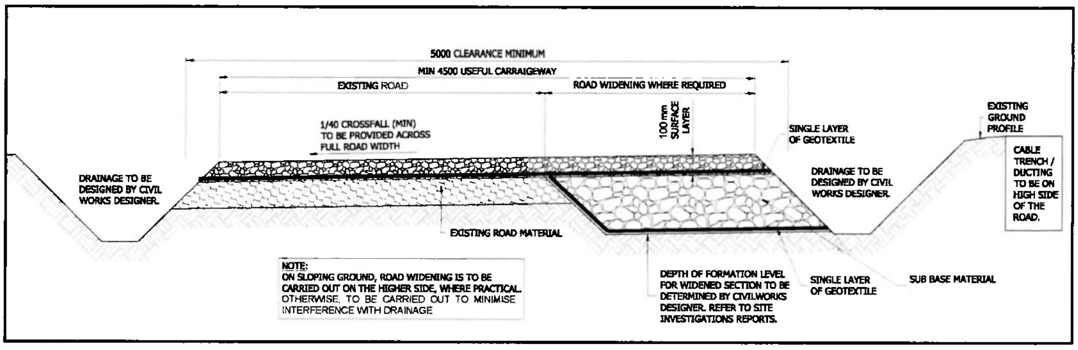


Plate 6-4: Illustration of Road Upgrade

For the construction of turbine foundations and hardstands, unsuitable material will also need to be removed. This will include at a minimum the peat and any soft tills. The volumes of peat to be cleared for turbine and hardstand construction is summarised in Table 6-15. The area to be cleared of peat is measured from the site plan which shows the cut and fill areas around the hardstand and an excavation diameter of 26m is taken as the worst-case scenario for the turbine foundation with a 22.5m diameter.

Table 6-15: Summary of Peat Spoil – Turbine & Substation Construction

Turbine	Area (m^2)	Peat / Topsoil Depth$_{avg}$ (m)	Peat / Topsoil Vol (m^3)
T01	4,520	0.4	1,808
T02	3,653	0.6	2,192
T03	3,623	1.0	3,623
T04	3,181	0.4	1,273
T05	4,443	1.0	4,443
T06	4,408	0.8	3,527
T07	4,513	0.7	3,159
T08	3,656	0.6	2,194
Substation	2,804	0.8	2,243
Construction Compound	1,393	0.5	697
TOTAL	**---**	**---**	**25,160**

The met mast location is on an area of cutaway with an existing access road, so its construction will not generate any significant amount of peat. From Tables 6-14 and 6-15, the total estimated volume of peat to be excavated is 48,048m^3.

The depth of suitable bearing strata at each turbine location will be determined during detailed ground investigation required for foundation design. However, based on the observations of ground conditions at the eight locations, rock is found at shallow depths. The bedrock has sufficient bearing capacity for the proposed turbines – circa 300kN/m^2.

In addition to the rock won on site for road construction, the estimated volumes of stone to be imported for road and hardstands is provided in Table 6-16.

Table 6-16: Estimate of Aggregate Import Requirements

Construction Element	Length (m)	Width (m)	Area (m²)	Aggregate Thickness (m)	Aggregate Volume (m³)
On-Site Roads	4,500	4.5	---	0.1	2,025
Transport Route Upgrade	670	4.5	---	0.5	1,508
Hardstands	---	---	34,082	0.1	3,408
Road Strengthening	6,600	0.6	---	0.4	1,584
TOTAL					8525

The use of products from authorised quarries is considered a slight positive permanent impact as these facilities are exploiting a recognised natural resource and will have appropriate environmental controls.

Peat Regeneration Areas

In total, 48,048m^3 of peat spoil will be generated during the construction phase. This peat will be reused to restore and landscape along site roads and around slopes of hardstands on an on-going basis. Excess peat will be taken to peat regeneration areas.

Grid Connection

The grid connection route is approximately 7.3km long. The cable ducting will be installed in a trench with approximate dimensions of 1.25m deep and 0.6m wide. Its excavation will generate approximately 5,475m^3 of spoil. This will consist of a range of materials, from tarmac, clause 804, tills, peat and rock. For off-road sections of the cable route, some excavated material may be suitable for reuse. However, for material excavated along the public road, it will not be reused as backfill. Depending on the timing of this work, it may be suitable for reuse on the wind farm. However, it may need to be taken directly, by an appropriately permitted contractor, off site to an appropriately licensed facility for recovery and/or disposal.

Additional material requirements associated with the cable route construction which will result in a permanent impact on local quarries are as follows:

- CBM material (lean-mix) around cable trenches = 2,519m^3.
- Clause 804 backfill to cable trenches = 2,956m^3.

These are approximate as the backfill used will vary depending on the location of the trench in the road / road verge. The use of products from authorised quarries is considered a slight positive permanent impact as these facilities are exploiting a recognised natural resource and will have appropriate environmental controls.

Hydrogeology & Groundwater

Removal of peat and subsoils may result in the exposure of the underlying rock to sources of contamination and may permanently increase the vulnerability of the aquifer within the development footprint. Pollution may occur as a result of spillage or leakage of fuels. Pollutants could enter the groundwater aquifer resulting in direct negative temporary localised moderate impacts. It could also have indirect negative temporary moderate impacts on local ecology and, due to separation distances have indirect negative temporary slight impacts on local private water supplies.

One private well (dug well) serving a domestic dwelling was identified at the wind farm, approximately 100m to the west and cross gradient from the road to turbines T01/T02. The development is not expected to have any impact on this well. Two bored wells and a spring used for drinking water supply are located to the southeast of the substation location. The closest is the spring (W9 on Figure 6-3), which is 220m downgradient of the substation. In is unlikely that the construction of the substation will affect yields at the spring or bored wells due to the shallow depth of excavation for the substation and the separation distances.

There is potential to encounter groundwater during the excavation of the cable trenches for the grid connection. As excavations will be shallow, approximately 1.25m deep, it is considered unlikely that groundwater will be encountered for much of the route. However, if groundwater is encountered and builds up in the trench, it may need to be removed from the trench for the ducting and CBM to be placed; small amounts of groundwater would not need to be removed. Water removed will be managed so it does not present a risk to the nearby watercourses – refer to Chapter 7.

During construction, there will up to 30 people working on site depending on the activities. Workers will generate foul effluent at the site compound. If not managed properly, it presents a localized short-term moderate negative impact on groundwater quality (and potentially surface water).

Other Potential Impacts

Other potential impacts on geology and hydrogeology include:

- Erosion of peat during discharge of water during dewatering of turbine foundations, if required.
- The removal of overburden/peat from the site to construct site roads, crane bases and turbine foundation will increase aquifer vulnerability locally. Although, the vulnerability is already classed by the GSI as extreme across much of the site.
- There will be an indirect impact on local quarries which will be used to provide concrete for the construction of turbine foundations. Approximately 4,800m^3 of concrete will be used for turbine foundations, 320m^3 for foundation blinding layer, 100m^3 for the met mast foundation and a further 500m^3 of concrete needed for the substation construction.

6.4.5. Operational Phase

There are no likely significant potential impacts on geology or hydrogeology during the operational phase of the wind farm. Some traffic will be associated with the maintenance of turbines and these maintenance vehicles and activities could result in minor accidental leaks or spills of fuel/oil. Unmitigated this would be a localised, imperceptible, temporary negative impact.

Maintenance of access roads will also require the occasional use of plant or machinery which could result in minor contamination as a result of leaks or spills due to an accident, breakdown or poor maintenance. Unmitigated this would be a localised, imperceptible, temporary negative impact.

The grid transformer at the on-site substation will be oil cooled and if not properly maintained or bunded, could result in contamination of the underlying/adjacent soils and/or groundwater. Grid transformers hold approximately 12m^3 of cooling oil.

Unmitigated this would be localised, slight to moderate, temporary to short-term negative impact.

A small amount of imported granular material may be required to maintain access roads during the operational phase which could impact the source quarry. Unmitigated this would be localised, imperceptible, permanent positive impact.

The substation will have welfare facilities for worker operating the wind farm and maintaining the substation. Foul effluent will need to be treated and presents a contamination risk to groundwater quality. Unmitigated this would be localised, imperceptible, long-term negative impact.

6.4.6. Decommissioning

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

During decommissioning, it may be possible to reverse or at least reduce some of the impacts caused during construction by rehabilitating some construction areas. This will be done by covering developed areas with locally sourced peat to encourage vegetation growth. Other impacts such as possible soil compaction and contamination by fuel leaks will remain during site restoration but will be of reduced magnitude.

6.5. Avoidance, Remedial or Reductive Measures

The avoidance and mitigation measures for the construction, operational and decommissioning phase are presented in the subsection below. Most relate to the construction phase.

6.5.1. Pre-Construction Ground Investigation

The mitigation measures to be employed to avoid, reduce and mitigate potential impacts on soils / geology are:

- Prior to mobilising to site for ground investigation works, the sequencing and route between locations will be designed to minimise trafficking. Egress routes will follow ingress routes where feasible.

- A wide-track excavator will be used to minimise compaction of vegetation and peat along the route.
- The material excavated from trial pits and cutting from boreholes will be replaced back into the excavation/borehole in reverse sequence. Trial pits/boreholes will be restored immediately after completion once all the necessary data and samples are collected. The surface vegetative layer will be placed right-way-up to restore the works area to original ground condition to avoid soil erosion.
- Absorbent pads/spill kits will be kept in the machines to immediately clean any spills or leaks.

6.5.2. Construction Phase

The site has been designed to avoid the risk of slope instability and other potential impacts on geology as far as possible. Turbine locations and road alignments have been changed to avoid deep peat and steep slopes during the assessment process. The residual risks associated with the construction of this wind farm site can be managed, and the following recommendations are given to achieve this.

1. A CEMP has been prepared for the development. This will be updated and finalised after the appointment of the civil engineering contractor and prior to the commencement of construction. The CEMP provides details on earthworks, including method statements for peat management, road construction, and grid connection installation. The CEMP also details emergency respond procedures.
2. The civil engineering contractor engaged to construct site tracks and turbine foundations will provide a method statement for all earthworks which will include the measures detailed in the CEMP. This will be reviewed and approved by a suitably qualified and experienced geotechnical engineer or engineering geologist, and hydrologist or drainage engineer.
3. The developer will appoint an Environmental/Ecological clerk of works (ECoW) for the duration of the construction project. The ECoW will have an ecological and environmental management background with practical experience of wind farm construction projects. The ECoW will monitor the environmental aspects of construction (soil storage, peat stability, day-to-day excavation works, etc.).

The ECoW will have the authority to instruct the contractor to implement additional mitigation measures, if deemed appropriate. The ECoW will maintain a written record of all environmental issues on site, including incidents and monitoring results. This file will be made available to the relevant Authorities upon request. The ECoW will be responsible for notifying the relevant Authorities of any environmental incident.

4. In addition to the day-to-day monitoring of excavation works by the ECoW, inspections of the excavation works (rock cuts, peat) will be carried out by suitably qualified and experienced geotechnical personnel.
5. Micro-siting of turbines will be permitted for geotechnical reasons should unforeseen ground conditions be encountered. A lateral move of up to 20m should be allowed with a vertical change of up to 3m. Micro-siting will be allowed once the turbines do not come any closer to the closest streams or sensitive ecological receptors.
6. To minimise soil erosion, earthworks will be suspended during extreme weather conditions. An extreme rainfall event will be classified as an event that corresponds to the Met Éireann Orange – Weather Alert for rainfall. The ECoW will monitor the weather forecast to make preparations ahead of adverse weather conditions.

Met Eireann Orange – Weather Alert for Rainfall
50 mm – 70 mm in 24 hrs
40 mm – 50 mm in 12 hrs
30 mm – 40 mm in 6 hrs

7. The proposed roads and hardstand areas will be set out by a surveyor. Excavation will then precede whereby peat and soft soils will be excavated and replaced with granular fill where required within the works corridor. Excavation will be carried out from access roads, where possible, in order to reduce soil compaction. Machinery will stay within the works corridor, as set out, so that compaction of soils outside the works area is avoided.
8. Peat and soil stripped will be used to restore road verges on an on-going basis as the road advances. This will reduce the volume of soil stockpiled and minimise soils exposed to erosion.

9. Peat regeneration areas have been identified to accommodate excess peat spoil. Areas where peat can be placed include the cutaway areas at the site entrance to turbines T01/T02, the improved grassland near turbine T04 and smaller areas at most turbine locations. Peat regeneration areas will have rock and earthen berms to contain peat. Peat will be placed to a depth not excessing 1.3m. The upper layer of peat excavated will be placed on top to facilitate re-vegetation and regeneration of the peat. No spoil stockpiles will be left on site after construction is completed. It is estimated that 48,048m^3 of peat spoil will be generated on the wind farm. This peat will be reused as follows:

   - Landscaping along 4.5km of roads' verges = 8,100m^3.
   - Landscaping around the lower edges of each hardstand = 1,920m^3
   - Landscaping around turbine foundations = 1,680m^3
   - Landscaping at the substation = 2,040m^3
   - Peat regeneration areas = 34,308m^3

   The peat generated at the transport route upgrade (2,814m^3) will be used entirely for road verge landscaping along that new road section, as will any peat / soil generated in road widening / strengthening works.

10. Peat / soil / rock will not be stockpiled on areas with slopes >5° or in areas with peat depth greater than 1m. Areas to be used for temporary stockpiles will be approved by the project geotechnical personnel.
11. Dewatering of excavations, if required will be to the drainage channels (via silt traps). Dewatering of excavations down slope of excavations in an uncontrolled overland flow fashion will not be permitted as this may lead to erosion of peat and overburden and silting of streams. The excavations for turbine foundations will be shallow (circa 3m), so dewatering is not anticipated.
12. Underground cabling will follow the track alignments where possible. Where this isn't practicable, wide track excavators will be used. The excavated material will be reused to backfill the trench. Peat turves (acrotelm) will be used to restore the trench. Duct installation and trench restoration will follow closely behind excavation.
13. Rock imported into site will be sourced from a quarry with similar geochemistry to the bedrock on site; limestone quarries will not be used.

14. Surface water management infrastructure will be installed as detailed in Chapter 7, which will avoid / reduce soil erosion.
15. Management of fuels and oils is also detailed in Chapter 7. These management proposals will avoid contamination of the bedrock aquifer.
16. Impact on domestic groundwater supply wells is not anticipated. If the quality or quantity of the well water supply is affected by the construction works, the developer will provide an alternative drinking water supply.
17. Chemical toilets and a sealed tank will be used during the construction phase to avoid discharges to ground or surface water. No impact on groundwater is envisaged.

6.5.3. Operational Phase

The mitigation measures for the operation phase of the wind farm are:

1. A geotechnical engineer will inspect the earthworks within 6 months of the commissioning the wind farm to ensure there are no stability issues. An ecologist will inspect the restored / landscaped areas of the site to ensure vegetation is established. Remedial works (additional planting or seeding) will be carried out as required.
2. Chemical toilets and a sealed tank will be used during the operational phases to avoid discharges to ground or surface water. No impact on groundwater is envisaged.
3. The grid transformer will be built on a plinth within a concrete bund. Any spills or leaks will be contained. Fuel stored on site for the back-up generator will be in a self-bunded tank. Contamination of soils and groundwater from these sources is not envisaged. Should a spill / leak occur, contaminated soil will be excavated and removed from site to an authorised facility to treat or dispose of this soil.
4. Aggregate used for road maintenance will be sourced from a quarry with similar geochemistry to the bedrock on site; limestone quarries will not be used.

6.5.4. Decommissioning

Mitigation measures employed during decommissioning activities will be similar to those used during construction. On decommissioning of the wind farm, cranes will be used to disassemble and remove the turbines. The foundations will be covered over with soil and peat and allowed to re-vegetate naturally. Leaving the foundation in place (rather than breaking out the concrete) is considered the most environmental benign approach. The Irish Wind Energy Association (IWEA) states that when decommissioning a wind farm '*the concrete bases could be removed, but it may be better to leave them under the ground, as this causes less disturbanc*e'.

The roads will be left in place and used to access the farmland and forestry of the site. The on-site substation is also likely to be left in place and become part of the National grid. Otherwise, it would be removed, and the site restored to agricultural lands.

6.6. Predicted Impacts of the Proposal

With the implementation of these avoidance and mitigation measures, the predicted impacts of the proposed development are:

1. The excavation of peat for foundations and crane platforms cannot be avoided. This will result in peat spoil. This is predicted as a moderate long-term negative impact.
2. The risk of peat instability cannot be eliminated completely. However, with the relocation of turbines away from areas with deep peat as far as possible and the realignment of roads away from areas with deep peat, the risk of construction-related peat landslide is negligible, and it is unlikely to occur. Monitoring will be conducted during construction to ensure it does not occur.
3. The use of rock and aggregate (for concrete production) from local quarries is also unavoidable. This is an imperceptible permanent positive impact.

6.6.1. Worst-case Scenario

'Worst case' effects are defined as those arising from a project in the case where mitigation measures substantially fail[3]. The theoretical worst-case scenario would be a peat landslide that would impact on water quality in streams draining the site. However, this is a hypothetical scenario as it is determined that a peat landslide occurring is unlikely and the indicative risk level is negligible. The mitigation measures include avoidance of areas of deep peat in the road layout so that floating roads are not required, avoidance of stockpiling of excavated material on deep peat or slopes greater than 5°, and a minimum setback for soil stockpiles of 50m from streams. Therefore, a worst-case scenario for soils & geology would include localised contamination of soils from fuel spillage, localised slumping of soil stockpiles, or greater volumes of soil excavation than estimated perhaps requiring off-site disposal.

6.7. Monitoring

Suitably qualified persons will carry out monitoring of construction activities, with a view to identifying unstable areas and proposing suitable remedial works, if necessary. During construction, monitoring will be conducted in areas of deep peat near the construction works and within the peat regeneration areas. This will include the use of depth settlement plates (for peat settlement), and monitoring pegs (for lateral displacement) as specified by the geotechnical engineer.

6.8. Difficulties Encountered in Compiling

Some parts of the site have commercial forestry, so access is limited to firebreaks and where trees failed. In dense forestry, GPS positioning is also lost. Otherwise, there were no difficulties encountered in the compiling the soils and geology chapter.

6.9. Interactions

Interactions associated with soils / geology with other aspects of the environment include:

[3] Guidelines on the information to be contained in Environmental Impact Statement Reports – draft, EPA, August 2017.

- The use of site-won stone for the construction of roads and cranage areas in a cut/fill construction method. The consequence of this is a reduction in traffic to / from local quarries; a positive impact. There is however an increase in noise and vibration associated with the winning of rock; a temporary negative impact.
- There will be aggregate and concrete imported from local quarries. This will have an impact on the volume of HGV traffic on local roads.
- There is a close association and interaction between soils and the habitats that the various soil types support. The removal of soils will result in a loss of habitat within the development footprint for these flora and fauna that depend on them for food and shelter.
- For blanket bogs, there is an important interaction between flora, fauna, soil and hydrology. The interaction of these factors is a dynamic relationship. Blanket bogs were formed in the last 6,000 years when the conditions of high rainfall & low temperature, poor drainage and plant growth coincided - primarily along the western seaboard of Ireland. Poor drainage generally developed with the creation of an iron pan in the soil layer which inhibited the downward migration of rainwater. Water-lodged conditions developed and when plants died, the lack of oxygen in the water-lodged conditions inhibited decay, resulting in the development of peat. Various plants such as mosses, heather, sedges, grasses and lichen preferably occupied the varied habitats within the blanket bogs. The growth of the blanket bogs is approximately 1mm per year.

  As the peat develops, the underlying geology (soils and bedrock) becomes less and less important. The peat forms a barrier between the surface vegetation / habitats and the underlying geology. The surface hydrology derived from rainfall runoff and the topography (depressions in the peat) is much more relevant and determines the make-up of plant communities. For example, depressions receiving overland runoff will remain water-lodged and particular plant assemblages will develop and thrive. If a road were to cut through the catchment to this depression, then it might result in diversion of water from the water-lodged area with an indirect impact on the plant assemblages. For this reason, particular attention was given to the road construction in terms of alignment and drainage.

Blanket bogs are generally more important for the birdlife they support rather than mammals. Typical mammals associated with bogs are hare, otters (near rivers / streams), deer and fox. These mammals are not however dependent on the bogs and are commonly found in other habitats.

6.10. Conclusions

The Graffy Wind Farm will be developed on the lower slopes of the Aghla Mountain. The geology consists of a thin layer of peat across much of the hillside resting on tills or bedrock. Deeper peat deposits are present but isolated and confined by rock ridges. Bedrock outcrop is frequent and consists of metamorphic rocks of varying composition. Bedrock aquifers are only capable of supplying domestic wells. With wind farm developments on peatland, peat slippage is an important factor and can be avoided during the design of the wind farm layout. The overall conclusion is that a peat landslide occurring is unlikely and the indicative risk level is negligible. With avoidance and mitigation measures, impacts on soils, geology and hydrogeology will not be significant.

7. Hydrology

Contents

Contents

7. WATER

7.1 Introduction

This chapter of the EIAR was prepared by KGEC. It addresses surface water and hydrology in the existing environment, the potential direct and indirect impacts of the proposed wind farm on surface water and the proposed mitigation measures to avoid or reduce potential impacts. It assesses the cumulative impact on surface water of the proposed wind farm with other developments in the immediate environs. It assesses the off-site impacts associated with the upgrade of the transport route for over-sized loads and the grid connection for the development. It presents a detailed and site-specific drainage design, sediment control and erosion plan. Construction phase, operational phase and decommissioning are considered. Aquatic ecology of the site was assessed by RPS Ltd and is presented in Chapter 10(iv). Groundwater is assessed in Chapter 7 (Soils).

A full description of the proposed development is provided in Chapter 2. In summary the development will consist of a wind farm with 8 No. turbines, access roads, hardstands, substation, grid connection and improvements to the turbine delivery route. Sections of the wind farm roads and the delivery route upgrade pass through commercial forestry and one turbine is located in commercial forestry, so 'keyhole' felling will be required prior to road construction and additional felling required for bat mitigation requirements. A permanent met mast will also be erected at the location of the existing temporary met mast.

This chapter was prepared by Keohane Geological & Environmental Consultancy (KGEC). KGEC is a Cork-based consultancy specialising in geological and environmental sciences. Mr. Keohane has over 25 years' experience in environmental assessment. In the past 20 years, KGEC has prepared planning applications, EISs and/or geotechnical assessments for over 40 wind farm developments throughout Ireland and UK. He has also been involved in the construction of over 30 wind farms in Ireland.

7.1.1 Scope & Purpose

This chapter of the EIAR provides details of the surface water environment in which the development is proposed. It identifies the surface water catchments, drainage patterns, surface water uses, run-off characteristics, peatland hydrology, and flood risk. It provides baseline surface water quality data based on publicly available information and monitoring carried out as part of this assessment.

The purpose of the assessment is to qualify the surface water importance of the receiving environment, identify and quantify the potential direct impacts of the proposed development on the hydrology (surface water quality, run-off characteristics etc.) within the site and potential indirect impacts beyond the site boundary; to assess the potential impacts in the context of other developments (proposed / completed) to determine cumulative effects. Having identified and quantified the potential impacts, to recommend measures to avoid, mitigate and/or reduce significant potential negative impacts for the construction and operational phases of the development. To audit the effectiveness of the mitigation measures, a site-specific surface water quality monitoring programme is also outlined.

7.1.2 Policies & Guidelines

There are several local, national and international policies and guidelines relied upon in the preparation of this chapter. These include:

1. Water Framework Directive (2000/60/EC).
2. County Donegal Development Plan 2018-2024.
3. Department of the Environment, Heritage & Local Government, June 2006. *Wind Farm Development – Planning Guidelines.*
4. Department of Housing, Planning and Local Government, December 2019. *Draft Revised Wind Energy Development Guidelines.*
5. Irish Wind Energy Association, 2012, *Best Practice Guidelines for the Irish Wind Energy Industry.*
6. National Roads Authority, 2008. Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.
7. Office of Public Works (OPW), November 2009. *The Planning System and Flood Risk Management Guidelines for Planning Authorities*.
8. Department of the Environment, Community and Local Government, 13 August 2014. *Use of OPW Flood Mapping in Assessing Planning Applications, and Clarifications of Advice Contained in the 2009 DECLG Guidelines for Planning Authorities – "The Planning System and Flood Risk Management*". Circular PL 2/2014.
9. Construction Industry Research and Information Association (CIRIA), 2015. *Site Handbook for the Construction of SuDS: Technical Guidance C753.*

10. Construction Industry Research and Information Association (CIRIA), 2017. The SuDS Manual: Technical Guidance C698.
11. Construction Industry Research and Information Association (CIRIA), 2006. *Control of Water Pollution from Linear Construction Sites: Technical Guidance C698*.
12. Construction Industry Research and Information Association (CIRIA), 2001. Control of Water Pollution from Construction Sites. Guidance for Consultants and Contractors: Technical Guidance C532.
13. Environmental Protection Agency, 2002. Guidelines on the information to be contained in Environmental Impact Statements.
14. Environmental Protection Agency, August 2017. Guidelines on the information to be contained in Environmental Impact Statement Reports – draft.
15. Environmental Protection Agency, 2003. Advice Notes on current practice in the preparation of Environmental Impact Statements.
16. Welstead, J., Hirst, R., Keogh, D., Robb G. and Bainsfair, R. 2013. Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms. Scottish Natural Heritage Commissioned Report No. 591.
17. Scottish Natural Heritage, et al. 2019. Good Practice during Wind Farm Construction, 4th Edition.
18. Forest Service, Department of Marine and Natural Resources, 2000. Forestry and Water Quality Guidelines.
19. Forest Service, Department of Marine and Natural Resources, 2000. Forest Harvesting and Environmental Guidelines.
20. Eastern Regional Fisheries Board. Requirements for the Protection of Fisheries Habitat During Construction and Development Works at River Sites.

Wind Farm Planning Guidelines

The 2006 wind farm planning guidelines set out some general considerations for surface water. These are:

- Site drainage and hydrological effects, such as water supply and quality and watercourse crossings.
- Degradation of habitats through alteration or disturbance, in particular arising from changes to hydrology that may alter the surface or groundwater flows and levels, and drainage patterns critical in peatlands and river headwaters.

- Storage and transfer of material, including use of bounded storage areas for use during construction and operational phases to avoid any pollution of surface or ground waters.
- Avoid the excavation of drains, where possible, unless it is necessary for geotechnical or hydrological reasons.
- If drains are unavoidable, ensure that silt traps are constructed and that there is only diffuse discharge of water.
- Avoid blocking existing drains.
- Important features such as streams should be properly bridged or culverted.
- Culverts should be placed under roads, where appropriate, to preserve existing surface drainage channels.
- Carefully monitor and control any pumping of water from excavated turbine bases to ensure that water is directed into existing water courses, forestry drains or specially constructed drains, all with adequate capacity to deal with the volumes of water encountered.

In addition to the above, the 2019 draft wind farm guidelines require/recommend that:

- Developers and the Local Authority should have regard to the Water Framework Directive and support the implementation of the relevant recommendations and measures as outlined in the relevant River Basin Management Plan.
- A flood risk assessment be carried out in accordance with the 2009 flood risk management guidelines.
- A Construction Environment Management Plans (CEMPs) be prepared prior to construction and include the mitigation measures detailed in the EIAR. A draft should be submitted with the planning application. In relation to surface water, the following is recommended to be included in the CEMP:
    - containment of all construction-related fuel and oil within specially constructed bunds to ensure that fuel spillages are fully contained; such bunds shall be roofed to exclude rainwater.
    - a water and sediment management plan, providing for means to ensure that surface water run-off is controlled such that no silt or other pollutants enter local water courses or drains.
    - details of a water quality monitoring and sampling plan.

County Development Plan

The County Development Plan (2018 – 2024) sets out several objectives and policies for the protection of waters. Those that are relevant to the proposed development include:

WES-O-4: To implement the EU Water Framework Directive through the implementation of the appropriate River Basin Management Plan and Programme of Measures as it affects Donegal.

WES-O-5: To maintain, protect, improve and enhance the quality of surface waters and ground waters in accordance with the Programme of Measures contained within the relevant River Basin Management Plan.

WES-O-6: To provide for environmental protection, through:

- The protection of surface water and ground water from pollution in accordance with the River Basin Management Plan, Groundwater Protection Scheme and Source Protection Plans for public water supplies.

WES–P–8 Groundwater Protection

It is the policy of the Council to protect all waters, including any sites on the Water Framework Directive Register of Protected Areas, through supporting and facilitating Irish Water with its environmental protection programme (including the Programme of Measures contained within the relevant River Basin Management Plan; and through the land use planning system.

Controls will be based on a risk management approach, which seeks to establish the nature of the hazard, the vulnerability of the groundwater body and the potential consequences of a contamination event. Within Donegal there are a number of locally important aquifers, which store large quantities of water and are capable of storing water for small group and village schemes. (Public Groundwater Abstraction points and associated Groundwater Protection Plans can be viewed on the Councils website.

F-P-1: It is a policy of the Council to ensure that all development proposals comply with 'The Planning System and Flood Risk Management - Guidelines for Planning Authorities', November 2009, DoEHLG.

7.1.3 Sources of Baseline Information

Sources of baseline information and the literature reviewed for the study area include:

1. Surface water data including catchments, flows, surface water quality etc - Environmental Protection Agency www.epa.ie, www.catchments.ie and http://www.wfdireland.ie/maps.html
2. Historical flood information and flood risk maps - Office of Public Works www.opw.ie , www.cframs.ie and www.floodmaps.ie
3. Rainfall data - Met Eireann www.met.ie
4. Designated sites – National Parks & Wildlife Service www.npws.ie
5. Peatland Hydrology – Geomorphology of Upland Peat, Evans and Warburton, 2010.
6. Peatland Hydrology, October 2011. IUCN UK Peatland Programme, Draft Scientific Review.
7. Mully/Graffy Wind Farm, Environmental Impact Statement, 2009.

7.1.4 Consultation

As part of the EIA process, consultation was carried out with organisations and individuals regarding the proposed development, namely IFI and OPW. One organisation contacted gave advises relating to surface water and hydrology – i.e. IFI. The list of consultee bodies and their response are contained in Table 1.1 and 1.1A in Chapter 1 (Introduction), while the consultee bodies scoping document and responses are set out in Appendix 1 of Volume 3. The relevant response is summarised here and incorporated, where appropriate, into the avoidance, mitigation and monitoring proposals for the proposed wind farm development.

Inland Fisheries Ireland (IFI)

IFI responded by email on 22 May 2019 as follows: *We wish to advise that our correspondence to the planning authority on the original application 09/30520 and to An Bord Pleanala PL 05 B.237656 should be noted. Notwithstanding this, the proposed development will of course be examined in detail and our response will be based on the application as presented.* The Northern Regional Fisheries Board (NRFB – now IFI) submission on the original application (planning number 09/30520) is provided in Appendix 1 of Volume 3 for convenience. The consultation details measures to protect water quality and the sensitive aquatic habitats they support.

7.1.5 Assessment Methodology

The assessment of surface water was carried out with reference to relevant policies, regulations and guidelines and following this general methodology:

1. The preliminary design of the proposed development was reviewed to identify elements which could have the potential to impact on surface water.
2. Consultation was carried out with agencies with an interest in the surface water environment, including IFI (refer to Section 7.1.4.).
3. A literature review was carried out to determine any policies and / or guidelines to which the proposal should have regard.
4. A desk-based assessment of the surface water setting relevant to the proposed development was undertaken. This included a review of the planning documentation associated with the original planning application. The importance and sensitivity of the receiving surface water environment were identified during the desk-based assessment.
5. A field survey was conducted to map site drainage and collect baseline surface water quality.
6. Review of the ecology report prepared for the site by RPS Group to assess the interaction of surface water with ecology.
7. Findings from the desk-based study and field surveys were used to modify the site layout and / or construction techniques. Alternatives were considered for turbine locations, substation location, wind farm access roads and construction of the grid connection.

The site walkovers and collection of data were carried out on several occasions between October 2018 and December 2020. Data collected included:

1. Mapping of surface water drainage.
2. Collection of surface water quality.
3. Identification of local users of surface water for drinking water supply.

The information collected during the desk-based assessment and site walkover were used to establish the importance, quality and sensitivity of the receiving surface water environment. This follows the NRA (2008).

Table 7-1: Estimation of Importance of Hydrology Attributes

Importance	Criteria	Typical Examples
Extremely High	Attribute has a high quality 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 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) Flood plain protecting more than 50 residential or commercial properties from flooding. Nationally important amenity site for wide range of leisure activities.
High	Attribute has a high quality 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 supplying <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.

7.2 Surface Water in the Receiving Environment

The site is within the North Western River Basin Management District and within two hydrometric areas – areas 38 (Gweebarra-Sheephaven) and 01 (Foyle). The eastern side of the wind farm site (turbines 01 to 04) and the access road upgrades are in hydrometric area 01. The western side of the site (turbines 05 to 08 and the substation) and the grid connection are within hydrometric area 38. Hydrometric Area No 01 includes the surface catchment drained by the

River Foyle and by all streams entering tidal water between Culmore Point, County Derry and Coolkeeragh, County Derry. It is in the jurisdiction of the Loughs Agency. Hydrometric Area No 38 includes the surface catchment drained by all streams entering tidal water in Gweebarra River, Sheephaven Bay and between Rossan Point and Fanad Head, County Donegal.

The western side of the wind farm site and grid connection route are drained by the Stracashel River and its tributaries. The Stracashel River rises in Clogher North, just a few kilometres to the east of the site. It flows in a westerly direction towards Glenties. The grid route follows the public road on the north side of the Stracashel River, before crossing the river at an existing Coillte bridge at Meenamalragh / Drumconcoose. It follows a forestry road on the south side of the Stracashel River to the existing Tievebrack substation. Before reaching Glenties the Stracashel River meets the Shallogan River. The catchment area of the Stracashel River to its confluence with the Shallogan River is 20.5km^2. Of this, approximately 230ha is located within the landholding for the proposed wind farm. To the southwest of Glenties, the Stracashel River joins the Owenea River. The Owenea River discharges to the sea near Ardara.

The eastern side of the site is drained by the Stranagoppoge River. The Stranagoppoge River rises in the Aghla Mountains and flows in a general north-easterly direction. It joins the Finn River at Bellanamore. The catchment area of the Stranagoppoge River to its confluence with the Finn River is 18.3km^2. Of this, approximately 200ha is located within the landholding for the proposed wind farm. The Finn River flows in a general easterly direction through Ballybofey and Strabane, where it is called the Foyle River. It discharges to Lough Foyle at Derry.

Catchment areas are shown on Figure 7-1 (source https://gis.epa.ie/EPAMaps/). Plate 7-1 shows photographs of the Stracashel River and Stranagoppoge River at Graffy Bridge and the forestry bridge, respectively.

Plate 7-1: View of the Stracashel River & Stranagoppoge River

The site is drained by many mountain streams which drain to the Stracashel and Stranagoppoge rivers. They are generally fast flowing on bedrock and / or cobble beds. They are typically <0.5m wide, but up to 2.5m wide. Plate 7-2 shows the typical streams draining the site. The EPA-designated streams on the site are shown on Figure 7-2. It is noted that these streams do not reflect flow paths on the ground at a few locations. The flow paths are shown on Figure 7-3 to 7-9. Detail drainage at each turbine location and substation are shown on Figures 7-3 to 7-11.

Plate 7-2: Examples of Streams on Wind Farm Site

There are a number of designated sites within the vicinity of the proposed wind farm site. The closest are listed in Table 7-2. These are shown on Figure 10(i)-6 in chapter 10(i) Terrestrial Ecology.

Table 7-2: Summary of Designated Sites near Wind Farm

Site Name	Site Code	Location
West of Ardara / Maas Road SAC	000197	Extends west along the valley of the Stracashel River downstream of Graffy Bridge
West of Ardara/Maas Road NHA	000197	Extends along the Owenea River, including the section downstream of its confluence with the Stracashel River near Glenties.
River Finn SAC	002301	Extends east along the valley of the Stranagoppoge River downstream of the public road running along the southern side of the wind farm site.

The Owenea River catchment is one of six freshwater pearl mussel catchments in County Donegal, as listed in Section 5.3 of Part D of the CDP (Environmental Report). Discussion of aquatic habitats is provided in Chapters 10(iv) - Aquatic Ecology - and 10(v) – Freshwater Pearl Mussel.

7.2.1 Run-off Estimates

The nearest synoptic weather station to the site is Malin Head (241900 / 458600), 78km to the north-east of the site at an elevation of 22mOD. The mean monthly rainfall for Malin Head synoptic station is summarised in Table 7-3 The long-term average rainfall for Malin Head is approximately 1,100 mm/annum. An extreme rainfall event of 60mm/day was recorded during the 30-year period 1981 to 2010. One of the nearest rain gauge stations is located at Fintown (Kingarrow) 4.5km to the northeast, at an elevation of 155mOD. Rainfall amounts for 2018 and 2019 for Fintown are provided in Table 8-3. An extreme rainfall event of 58.8mm/day was recorded in 2018 at Fintown. The similar elevation and proximity of Fintown means that it is more representative of the wind farm site than the long-term rainfall for Malin Head. Met Eireann also provide 30-year (1981 to 2010) rainfall amounts for 1km x 1km grids across the county. This indicates that the long-term rainfall amount for the site is 2,064mm/annum.

Table 7-3. Month lyand Annual Avera ge Rainfalls (mm)

Malin Head													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
1971 - 199 0	121.7	85.5	89.2	61.7	55.8	66.1	76.8	92	99.8	115.4	1 B.1	116	**1,094.2**
1981 - 2010	117 4	84.8	85 9	63 1	569	691	76.8	93 2	91 .8	118 4	104 .5	114 .2	**1 ,076**
Greatest Daily Total –Malin Head													
1981 - 2010	326	34.3	31.4	26.3	35	26.7	38.7	49.9	48.6	60	31.6	39.6	**6 0**
Fintown (Kingarrow)													
2018	2 97.9	134.9	74. 2	1 21.6	66.8	54.7	105.9	212	149.8	200.8	142.1	180.6	**1 741.3**
2019	120.4	164.8	250	65	120.1	99.9	109.8	2 81.3	236.9	139.9	117.6	228.3	**1 ,934**

The catchment characteristics are quantified as soil type 5 (very low winter rain acceptance potential). The run-off co-efficient of the site is estimated at 0.5. There is poor soil cover, with rock outcrop frequent and average slopes of 7°. The potential for soakage is minimal. Based on the mean annual gridded rainfall data for 1km x 1km grid 190000/397000, Q_{BAR} for:

- the 367ha landbank in the northern part of the Stracashel River catchment is estimated at 8.1m^3/sec (see Figure 7-1 showing referenced area).
- the 204ha landbank in the northern part of the Stranagoppoge River catchment is estimated at 4.5m^3/sec (see Figure 7-1 showing referenced area).

There are several gauging stations on the rivers draining the site. The closest downstream are on the Stracashel River near Glenties and on the Finn River near Ballybofey. To estimate the flows in the rivers the online EPA Hydrotool was used. The 95%tile flow for the Stracashel

River (to a point just downstream of Graffy Bridge) is 0.032m^3/sec for the 9.5km^2 catchment. The 95%tile flow for the Stranagoppoge River (to Tievereagh) is 0.02m^3/sec for the 6km^2 catchment. The Hydrotool reports are provided in Appendix 7-1.

7.2.2 Surface Water Quality

The EPA monitors water quality on the rivers draining the site and their tributaries and the most recent available data from http://gis.epa.ie/Envision/ is summarised in Table 7-4 for the stations downstream of the site. The EPA monitoring stations nearest the wind farm site are shown on Figure 7-1.

Table 7-4: EPA Water Quality Data

River	Monitoring Location	Q-value
Stracashel	Bridge near Graffy School	Q5 (1990 result)
	S.S.W. of Meenamalragh	Q4 (2012 result)
	Just u/s Shallogan confluence	Q4 (2018 result)
	Bridge d/s Shallogan River	Q4 (2018 result)
	Bridge S.E. of Woodtown	Q5 (1981 result)
	500 m d/s Bridge in Glenties	Q4 (2018 result)
Stranagoppoge	Bridge W Tieveragh	Q3-4 (2019 result)
	Bridge u/s Finn River confluence	Q3-4 (2020 result)
Finn	Bridge S. of Bellanamor	Q4 (2019 result)

Based on the most recent data (from 2018, 2019 and 2020), the water quality in the streams and rivers draining the site has moderate (Q3-4) to good (Q4) status. The River Waterbody WFD Status 2013-2018 for the Stracashel River is Good and for the Stranagoppoge River is Moderate. The Stracashel River is assigned 'Not at Risk', while the Stranagoppoge River is assigned 'At Risk'. Further water quality assessment is provided in Chapter 10(iv).

Measurement of field parameters were taken in the streams draining the site on 26 May 2019. Measurements recorded are provided in Table 7-5. Locations are shown on Figure 7-2.

Table 7-5: Surface Water Field Measurements

Parameter	Units	Sample ID										
		FM1	FM2	FM3	FM4	FM5	FM6	FM7	FM8	FM9	FM10	FM11
Temp	°C	14.4	15.43	13.9	13.7	12.3	11.4	16.0	14	17.4	1 7.3	16.9
pH	pH Units	81 9	8.0	8.16	8.28	7.85	7.16	7.8	7.91	8.22	7.95	7 .76
EC	µS/cm	205	222	182	209	204	203	217	208	299	213	205
DO	%O_2 (mg/l)	85.7 (8.81)	83.5 (8.4)	74.7 (7.75)	75.2 (783)	68.4 (733)	65.3 (7.15)	75.9 (7.53)	65.2 (675)	64 (6.1 9)	80 (779)	92.6 (913)
Turb.	NTU	0.4	0	0	0	0	0	0	0	0	13.5	0
TDS	mg/l	133	144	118	135	132	131	141	135	194	138	133

Notes:

EC - Electrical Conductivity

Turb. - Turbidity

TDS - Total Dissolved Solids

Surface water samples were collected on 12 August 2020 and sent to Element Laboratory for analysis. Sample results are summarised in Table 7-6 and laboratory reports are provided in Appendix 7-2. Photographs of sampling locations are provided in Appendix 7-3.

Table 7-6: Surface Water Quality Data – August 2020

Parameter	Units	Sample ID									
		WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ7	WQ8	WQ9	WQ10
Temp*	°C	16.9	1 5.6	16.6	14.6	15.1	14.9	1 53	14.4	16.1	17.0
pH*	pH Units	7.25	6.96	7.28	7.27	6.82	6.85	6.7 8	7.19	7.09	7.14
Apparent Colour	hazen	163	144	244	187	422	357	229	117	300	262
TSS	mg/l	< 10	<10	<10	<10	<10	<10	<10	<10	<10	<1 0
Nitrate (as N)	mg/l	<0.05	< 0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrite (as N)	mg/l	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Total Oxidised Nitrogen (as N)	mg/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<02	<0.2
Ortho-Phosphate (as P)	mg/l	<0.03	<0.03	<0.03	<0.03	< 003	<0.03	<0.03	<0.03	<0.03	<0.03
Ammoniacal Nitrogen (as - N)	mg/l	<0.03	0.03	<0.03	<0.03	0.06	0.04	<0.03	0.03	<0.03	<0.03
Turbidity	NTU	2.7	2.9	4.6	4.1	10.7	15.3	4.6	2.1	5.8	4.0
BOD	mg/l	<1	<1	<1	< 1	<1	<1	<1	<1	<1	<1
Free Ammonia (as NH_3)	mg/l	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0007
Total Phosphorus	µg/l	54	40	47	37	56	50	35	26	44	44

Notes:

* - indicates field measurement.

The water quality field measurements and samples analysed indicate that the streams draining the site are unpolluted.

7.2.3 Peat Hydrology

Peatlands are defined as areas of deep peat soils with an organic layer deeper than 50cm. Water is the single most important factor to enable peat accumulation and water lodging is a prerequisite environmental parameter for peat formation and preservation; in most cases, peat consists of over 95% water by weight. Changes in the hydrological regime that sustains the peatland will invariably disturb the normal hydro-ecological functioning of the peatland.

There are several types of peatlands, namely fens, flushes, raised bogs and blanket bogs. Fens are distinguished from bogs in that they are connected to the groundwater system and thus receive water, nutrient, and mineral inputs from below. Fens are minerotrophic (minerals supplied by inflowing water), rheophilous or soligenous (water input other than precipitation – i.e. groundwater) and less acidic than bogs. These conditions control the vegetation present, with sedges and reed species dominant on fens. Fens and flushes can occur on bogs where there is a local input of water from springs or groundwater.

Bogs are hydrologically isolated from groundwater movement and rely on precipitation as the only water and nutrient input source. Bogs are ombrotrophic (receive all their water and nutrients from precipitation), acidic (pH <4) and are oligotrophic (low nutrient input and low amounts of calcium and magnesium). These conditions control the vegetation assemblages present, with Sphagnum dominant on bogs.

For peatland, water movement occurs predominantly in the upper acrotelm layer which is typically 10 to 70cm deep and consists of the actively growing vegetation and dead material not yet decomposed. Water movement (lateral discharge) in the underlying catotelm is negligible – between 0.5 and 1mm/year (Van der Schaaf, 1995[1]).

For blanket peatland such as that at the Graffy Wind Farm site, the drainage is largely unconstrained by topography. In these conditions, it is found that >1,300mm/year precipitation is needed to sustain the peatland. As noted above, data from Met Eireann indicates that the long-term rainfall for the site is 2,064mm/annum. With decreasing slope, the required rainfall volumes decrease.

[1] Van Der Schaaf, S, 1995. The influence of surface slope, acrotelm depth and drainage on groundwater level fluctuations at Raheenmore Bog, Ireland. Gunneria, 0, 97-115.

The main causes of blanket bog degradation include drainage, grazing, burning, afforestation, peat cutting and construction (i.e. roads, wind farms, etc). Drainage, afforestation, peat cutting, and road construction has occurred at the proposed wind farm site.

The peatland in which the wind farm is proposed generally has thin peat which has been drained for land improvement, turf cutting and forestry. To a lesser extent, roads have been constructed on the hillside. These man-made drains have altered the natural peatland hydrology at the site. The drains have two contradictory affects as follows:

1. The drains will transmit rainfall off the hillside more quickly and concentrate flows more than would otherwise be the case.
2. The drains lower the water table in the peatland providing greater storage capacity. [It should be noted that often-repeated description of peat as a "sponge" slowly releasing large amounts of water to a stream is erroneous; a wet sponge cannot hold much additional water]. However, once the storage capacity is reached, the drains on the hillside will control run-off characteristics; the increased storage capacity resulting from the drains only providing a brief reprieve.

The slope of the site will control which of these contradictory affects will dominate. For the Graffy site, the average slope of 7° will result in flashy run-off. There are flattish areas within the site, of limited extend, which will have limited storage capacity. Rainfall input will therefore have a rapid response of rising flow (discharge) in the drains / streams, then an almost equally rapid fall back to a very low base flow level.

7.2.4 Surface Water Usage

Donegal County Council and the North Western River Basin Management District project team were contacted for locations of surface water abstraction points on the rivers draining the site. Donegal County Council indicated that there are no Council drinking water abstraction points on the rivers downstream of the site. The drinking water source for the Glenties area is Lough Anna, which is located in the catchment of the Owenea River but is not downstream of the site. Lough Muck located in the catchment of the Stranagoppoge River is also used for drinking water supply (for the Fintown area). It is however not downstream of the wind farm site. Both water supply sources are shown on Figure 7-1.

The streams draining the site are used for water supply – mostly for agricultural use. At a number of locations, small weirs are used to restrict flows and small diameter intake pipes direct water, by gravity feed, to header tanks. Locations of these small surface water abstractions are shown on Figure 7-2.

7.2.5 Flood Risk Assessment

The Flood Risk Assessment (FRA) was carried out in accordance with the Office of Public Works (OPW) Flood Risk Management Guidelines as updated and clarified in 2014. Flood risk assessment is carried out in three stages, with increasing detail in progressive stages. The need for progression to a more detailed stage is dependent on the outcome of each stage until the level of detail of the FRA is appropriate or it has been demonstrated that flooding is not a relevant issue for the area or site. The three stages are:

1. Flood risk identification.
2. Initial flood risk assessment.
3. Detailed flood risk assessment.

Stage 1 - Flood Risk Identification

The purpose of this stage is to identify whether there may be any flooding or surface water management issues related to the proposed development site that may warrant further investigation. Several sources of reference information are available as outlined below.

National Flood Hazard Mapping

These digital maps, managed by the OPW, identify previous flooding incidents in Ireland. The surrounding areas including all the rivers in the catchment area of the site were investigated. There were no reported incidents of flooding at the site itself or immediately downstream of it. The closest flood incidences downstream of the site are at:

- Glenties – reoccurring flood of the Stracashel River.
- Welshtown – reoccurring flood of the Finn River.

The OPW flood extent mapping indicates that flooding of the Stracashel River is predicted to occur downstream of Glenties (for Annual Exceedance Probability (AEP) of 0.1%, 1% and 10%). These maps indicate that flooding of the Finn River is predicted to occur downstream of Ironworks (near Ballybofey). The wind farm site, road upgrades/construction and grid connection route are not within areas identified as being at risk of flooding.

Hydrology Impact Assessment

A hydrology impact assessment was carried out as part of the environmental assessment for the development to estimate the percentage increase in run-off from the site due to the development. For a 6-hour rain event with a 100-year return (80.8mm), the additional run-off is estimated at 1,993m^3, assuming impermeable surfaces used in the development footprint. This is a <0.5% increase over the estimated run-off for this storm event in the absence of the development. Potential down-gradient flooding is impacted by a significant increase in the run-off (rate and/or volume) at a development site. The hydrology impact assessment at the Graffy site concludes that the increase in run-off will be imperceptible.

As part of the hydrology impact assessment, a site walk over was carried out to map the drainage from the site. During this site walkover it was noted that the site itself was not at risk of flooding. There was no evidence of flood damage having occurred in the past; no signs of erosion/under cutting of stream banks or gravel cast onto stream banks. The conclusion of the site walkover is that the construction of the site infrastructure, road upgrades and grid connection can be completed with imperceptible change in current run-off characteristics.

Stage 2 - Initial Flood Risk Assessment

Flooding issues with respect to any development can affect three main areas. These are areas upgradient of the site, the site itself and down gradient of the site.

Flooding Risk Upgradient of the Site

The site is located on the lower to middle elevations of the Aghla Mountain. The wind farm development will not restrict surface water flows from the higher elevations (adequately sized culverts will be used to avoid backwater effects), so flooding up-gradient of the site resulting from the development will not occur. The grid connection will largely follow existing roads, existing surfaces will be restored with like-for-like materials, and equal / larger capacity culverts will be used when culvert replacement is required, so run-off characteristics will be unchanged.

Flooding Risk at the Site

The turbine and substation locations are situated on elevated sloping ground. While water lodging may occur on local flat areas of the site, flooding on the site itself is not a concern. There will be several streams and drains to be crossed, but with suitably sized culverts/clear span structures, backwater effects will be avoided. The grid connection follows existing roads, which according to available information are not liable to flooding.

Flooding Down Gradient of the Site

There have been no reported flooding incidents down gradient and in proximity of the site in either of the main rivers draining the site. There are however incidents of flooding along the lower reaches of the Stracashel and Finn rivers at Glenties and Ballybofey, respectively. Increased risks to flooding down gradient from the development are caused by an increase in run-off and a decrease in available water storage capacity at the development. The increased run-off from the site will be imperceptible and the development will not take up any flood storage capacity, so there is imperceptible increase risk of flooding downstream as a result of the proposed wind farm. The installation of the grid connection will not change run-off characteristics or available water storage capacity along its route.

The mitigation measures to reduce water run-off and maintain current water storage capacity at the wind farm site are as follows:

- Run-off from site roads and hardstanding will be directed to existing forestry drains for road sections passing through forestry. For roads and hardstanding on open hillside, run-off will be directed from roadside drainage into break-out locations to replicate a more naturalistic overland flow pattern.
- The roads to the turbines will follow topography which is undulating. Roads will have broad-based dips to force water from the road onto adjoining undisturbed land with sheet flow to existing flow paths.
- Hardstands and new roads will be made from hardcore and will not be impermeable, allowing absorption of rainfall thereby reducing the potential run-off volumes from the site.
- The trenches for the grid connection will be restored with like-for-like materials, so run-off characteristics will be unchanged.

Although the calculation for run-off increase assumes that the hardstands will have 1.0 run-off coefficient, the hardcore surface is more likely to have 0.5 run-off coefficient due to the collection of run-off within the voids of the material. The area of hardstands and new roads across the site affecting the run-off is approximately 1.6% of the surface water catchment areas in which the wind farm development is located. The change in surface water run-off and water storage capacity at the development leading to an increase in the risk to down gradient flooding is concluded to be imperceptible.

For the installation of the grid connection, the cable trench will be backfilled and restored with a like-for-like surface finish. No change in run-off characteristics is predicted.

Conclusion

Taking all of the above into account the following is concluded:

1. Risk of flooding upgradient of the development site is not increased by the development.
2. The risk of flooding at the site is very low due to the sloping nature of the site. There are some flat areas on the hillside where localised water lodging occurs. The development will not increase the occurrence or extent of this water lodging.
3. The amount of run-off going downgradient of the site will increase by an imperceptible amount. The increased risk of flooding downgradient of the site is therefore considered insignificant.

The flood risk identification has not identified any flood risk from the proposed development. As a result of these conclusions and in accordance with the guidelines there is no requirement to go any further in the staged process of the flood risk assessment.

7.2.6 Importance of Surface Water / Hydrology Attributes

Based on the NRA Guidelines, the importance of the site in terms of surface water and hydrology is rated as extremely high. While not extending into the proposed wind farm site, the receiving waters (into which the site drains) form part of two SACs (West of Ardara/Maas Road and Finn River), which are protected by EU legislation. The grid route along the public road is adjacent to the West of Ardara/Maas Road SAC at several locations for a total length of approximately 1.3km and it crosses the SAC for a length of approximately 50m at Meenamalragh / Drumconcoose.

7.3 Characteristics of the Proposed Development

The characteristics of the proposed development that could potentially have an impact on surface water quality and hydrology include:

1. Pre-construction site investigation works. To inform detail design of the turbine foundations, roads, grid connection etc, ground investigations will need to be undertaken. Some of these works will be intrusive investigation such as trial pit excavation and drilling. These works will expose soil to erosion from rainfall with potential to impact surface water quality. Streams will need to be crossed to access some locations.

2. Construction / upgrade of site access roads (internal roads and transport route).
    a. This work will include clearing of trees in places, stripping of peat / topsoil / soft subsoils to formation level and replanting. This will expose soil to erosion from rainfall with potential to impact surface water quality. The potential impact is primarily during the construction phase. Once landscaping is re-established the risk to surface water quality is very low.
    b. The construction of roads with roadside drainage will change the run-off characteristic of the site – i.e. incident rainfall could be delivered to the receiving water more quickly. The potential impact is primarily during the operational phase.
    c. Roads will cross drainage channels or streams and will need to be culverted. The potential impact on water quality is present during the construction phase. Blockages of culverts and impacts on flows are present during the operational phase.
3. Construction of cranage and assembly areas. These will have similar impacts to road construction in terms of water quality (during construction) and increased flow rates (during the operational phase).
4. Turbine foundation construction. Excavation of turbine foundations will have similar impacts to road construction in terms of water quality (during construction). Most of the foundation is covered over and landscaped, so increased run-off during the operational phase is imperceptible. Excavations are shallow (typically <5m) but could potentially extend into the groundwater table. This could require groundwater pumping during foundation construction. Concrete will be used in the construction of turbine foundations. Concrete has a high pH and if released into the surface water environment, could change its pH and affect aquatic fauna locally.
5. Construction of the on-site substation.
    a. This work will include stripping of peat / topsoil / soft subsoils to formation level. This will expose soil to erosion from rainfall with potential to impact surface water quality. The potential impact is primarily during the construction phase. Once landscaping is re-established the risk to surface water quality is very low.
    b. The construction of hardstand, concrete plinths and buildings will change the run-off characteristic of the site. The potential impact is primarily during the operational phase.

c. Concrete will be used in the construction of foundations and plinths in the substation compound.

d. The grid transformer is cooled by oil which presents a risk to surface water quality during construction when the transformer is being filled and during the operation phase if there is a spill or leak.

6. Use of potentially polluting materials.

   a. Plant and machinery on site use diesel. This is either stored or delivered to site in tanker trucks. There is potential for leaks or spills which could impact surface water and groundwater quality. The risk is present primarily during the construction phase and to a much lesser degree during the operational phase.

   b. Use of concrete in turbine foundations and substation foundations. As noted above, concrete has a high pH and if released into the surface water environment, could change its pH and affect aquatic fauna locally.

7. Installation of cabling.

   a. Installation of underground cabling will also require crossing of drains or streams, requiring minor instream works.

   b. Underground cabling can potentially provide a preferential flow path. The potential for this occurring is present during the operational phase.

8. Turbine towers. During the operational phase, driving rain is intercepted by the tower and run-off is concentrated at the base of the tower.

9. Grid Connection.

   a. Installation of underground cabling from the wind farm substation to the grid connection point at Tievebrack substation in Drumalough will also require crossing of drains / streams and bridges, presenting a potential risk to water quality from silt and hydrocarbons during construction.

   b. Some existing stone culverts may be damaged during trenching and will need to be replaced. This will present a potential risk to water quality from silt, and temporary disruption to flows.

   c. Along the road, concrete (lean-mix) will be used as backfill around the ducting. As noted, concrete has a high pH and presents a potential risk to the aquatic environment.

   d. Run-off water from excavated material could carry silt-laden water to the roadside drains and subsequently to the streams flowing to the Stracashel River.

e. Water (either groundwater or rainwater) build-up in the trench may need to be removed during duct installation. Improper disposal has the potential to release silt into the receiving waters.

f. For some stream crossing locations, horizontal directional drilling under the stream bed may be utilised during cable installation. Depending on the technology employed, drilling mud is used in this process and there is potential for break-out of drilling fluids.

g. Some existing culverts (mostly stone culverts) will need to be replaced along the route. This will require minor instream works with the potential for the release of silt into the receiving watercourses.

h. Underground cabling can potentially provide a preferential flow path. The potential for this occurring is present during the operational phase.

7.4 Impact Assessment

7.4.1 Impact Assessment Methodology

The criteria in the EPA (2017) draft Guidelines are used to evaluate and describe the potential impacts. These are set out in Table 7-7.

Table 7-7: Description of Potential Effects

Quality of Effects It is important to inform the non-specialist reader whether an effect is positive, negative or neutral	**Positive Effects** A change which improves the quality of the environment (for example, by increasing species diversity; or the improving reproductive capacity of an ecosystem, or by removing nuisances or improving amenities).
	Neutral 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 which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health or property or by causing nuisance).
Describing the Significance of Effects ''Significance' is a concept that can have different meanings for different topics – in the absence of specific definitions for different topics the following	**Imperceptible** An effect capable of measurement but without significant consequences.
	Not significant An effect which causes noticeable2 changes in the character of the environment but without significant consequences.
	Slight Effects An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.

definitions may be useful (also see *Determining Significance* below.).	**Moderate Effects** An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
	Significant Effects An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
	Very Significant An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
	Profound Effects An effect which obliterates sensitive characteristics.
Describing the Extent and Context of Effects Context can affect the perception of significance. It is important to establish if the effect is unique or, perhaps, commonly or increasingly experienced	**Extent** Describe the size of the area, the number of sites, and the proportion of a population affected by an effect.
	Context Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?).
Describing the Probability of Effects Descriptions of effects should establish how likely it is that the predicted effects will occur – so that the CA can take a view of the balance of risk over advantage when making a decision.	**Likely Effects** The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented.
	Unlikely Effects The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented.
Describing the Duration and Frequency of Effects 'Duration' is a concept that can have different meanings for different topics – in the absence of specific definitions for different topics the following definitions may be useful.	**Momentary Effects** Effects lasting from seconds to minutes.
	Brief Effects Effects lasting less than a day.
	Temporary Effects Effects lasting less than a year.
	Short-term Effects Effects lasting one to seven years.
	Medium-term Effects Effects lasting seven to fifteen years.
	Long-term Effects Effects lasting fifteen to sixty years.
	Permanent Effects Effects lasting over sixty years.
	Reversible Effects Effects that can be undone, for example through remediation or restoration.
	Frequency of Effects Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually).

The following sections detail the potential impacts, prior to mitigation, which have been identified from the assessment methodology presented above.

The main potential direct impacts of the development on the surface water environment are:

1. Deterioration of surface water quality from silt, concrete, drilling fluids and / or hydrocarbons.
2. Increase in run-off from a rainstorm event. This would increase the peak flow to the streams draining the site. The possible increase in run-off results from a change in the surface run-off coefficient due to turbine foundations and road construction. Changes in flow regime could also potentially arise from preferred pathways provided by cable trenches.
3. Culverting of drains and streams. Although installed during the construction stage, the potential impacts are associated with the operational phase.

Potential indirect impacts would be associated with deterioration of aquatic habitats resulting from pollution and potential for increased flooding downstream of the site and impacts on users of surface water as a drinking water supply downstream of the project. Also, changes in site run-off characteristics could potentially affect peatland hydrology.

7.4.2 Surface Water Quality

Pre-construction Ground Investigation

Ground investigation will need to be carried out to inform detail design of turbine foundations, substation foundations, road design, HDD techniques etc. Ground investigation will typically take the form of trial pit excavation, drilling and perhaps geophysical survey. From experience at other wind farm developments in similar terrain, trial pit excavations will be the main method. Drilling at HDD locations are also likely to be undertaken. The potential impacts to surface water associated with ground investigation works are:

- Accessing ground investigation locations with track-mounted excavator. The machine will need to cross watercourses, disturbing the stream bed which if unmitigated would result in direct momentary to brief imperceptible negative impact on water quality locally.

- Excavation of trial pits will expose excavated soils to erosion from rain and potentially increase sediment loading to streams. Unmitigated, sediment loading presents a direct brief imperceptible negative impact on water quality locally; an indirect brief imperceptible negative impact on habitats downstream of the site (e.g. if silt were to impact the sensitive aquatic habitats downstream of the site); and a brief imperceptible negative impact on local users of surface water.

- The potential impacts associated with drilling at HDD locations would depend on the drilling technique used. As a worse-case scenario some techniques recirculate water to remove cutting and advance the drill bit. The recirculating water (typically 400 to 500L) presents a risk to water quality of the adjacent watercourse. Unmitigated, release of recirculating drilling water presents a direct localised brief slight negative impact on water quality; and an indirect localised brief imperceptible negative impact on habitats downstream of the site (e.g. if silt were to impact the sensitive aquatic habitats downstream of the site.

<u>Construction Phase</u>

There is potential for direct and indirect impacts on surface water quality during construction activity from several sources. These activities are similar in nature for tree felling, the wind farm construction, transport route upgrades and grid connection works in that each activity presents a risk of releasing silt or other contaminants to adjacent watercourses. These are:

- Felling of trees, totalling 6.656 ha will be required. These are at a new road and junction widening to facilitate turbine delivery, corner widening along the delivery route, a service track through commercial forestry between turbine 4 and turbines 5/6 and mitigation felling for bats around T1, T4, T5 and T6.
- Felling would take approximately 4 weeks to complete. Felling activities have the potential to release silt into watercourses. Unmitigated, sediment loading from felling activities presents a direct temporary not significant negative impact on water quality; an indirect short-term slight negative impact on habitats downstream of the site (e.g. if silt were to impact the sensitive aquatic habitats downstream of the site); and a brief to temporary imperceptible negative impact on users of surface water.
- 6.82ha of replanting will be carried out at an off-site location. The proposed site is in Sonolaun and Kilmovee townlands in County Mayo.
- Increased sediment loading of drains and streams from earthworks activities. The construction of the wind farm would take approximately 12 to 14 months, with the main earthwork activities being carried out during the first 6 to 8 months. Unmitigated,

sediment loading presents a direct temporary slight negative impact on water quality locally; an indirect short-term significant negative impact on habitats downstream of the site (e.g. if silt were to impact the sensitive aquatic habitats downstream of the site); and a brief to temporary imperceptible negative impact on users of surface water locally. Once the earthworks and landscaping are completed, the risk of sediment loading of water courses is greatly reduced.

- Peat landslide risk with peat debris entering the streams and rivers draining the site. Peat landslide occurred in November 2020 during construction of a floating road at the Meenbog Wind Farm. The causes of this peat landslide are discussed in Section 6.4.4. As discussed in Section 6.4.4, the conditions and construction activities that contributed to this landslide are not present at the Graffy development site. The site-specific risk of construction-related peat landslide has been assessed for the Graffy Wind Farm. The conclusion of that assessment is that a peat landslide is unlikely to occur and the indicative risk level is negligible. As noted in Section 6.4.4, the peat slippage that occurred at Meenbog in terms of size, extent and negative effects of the environment can't occur at the Graffy site. This conclusion is based on the ground conditions encountered and the avoidance measures adopted in site layout and design. In the unlikely event of a peat landslide entering the streams draining the site it would present a direct short-term significant negative impact on water quality at and downstream of the site; an indirect short-term very significant negative impact on habitats downstream of the site (e.g. if peat debris were to impact the sensitive aquatic habitats downstream of the site); and a temporary slight negative impact on users of surface water locally.
- Potential spillage of oil and diesel used on site for plant and equipment. During construction there would be typically 8 to 10 machines on site (excavators, dump trucks, generators etc). These would be refuelled every 2 to 3 days. This is either done using refuelling bowsers owned by the plant hire contractor or refuelling by road tankers. Generators used at the site compound are typically fuelled from an on-site storage tank. The machines also use hydraulic oils and motor oils. There is potential for leaks and spillages of diesel or oils during refuelling, breakdowns (e.g. breaking of a hydraulic hose) etc. Unmitigated and depending on the volume released, hydrocarbons reaching the surface water environment would have a local direct temporary slight negative impact on water quality; an indirect temporary slight negative impact on habitats downstream; and a temporary slight negative impact on local users of surface water.

Hydrocarbons attenuate naturally in the environment, so any negative impacts are reversible.

- Release of cement to watercourses during concrete pours for foundations. For the proposed turbine, approximately 600m^3 (plus 40m^3 for the blinding layer) will be required per foundation – i.e. up to approximately 80 loads. For the 7.3km grid connection, there would be approximately 2,520m^3 of lean-mix concrete used as backfill requiring approximately 315 loads. The chutes of concrete trucks are typically rinsed down on site. If not carried out properly, concrete or concrete washdown water could reach watercourses, affecting its pH. Unmitigated, this would be a direct brief to temporary slight negative impact on local surface water quality.
- The grid connection route follows existing roads – public and Coillte roads. The bulk of the work will involve excavating a narrow trench (0.6m wide and 1.25m deep), installing ducting and placement and compaction of backfill. Once the trench is installed, the cables are pulled through and spliced at jointing bays. The potential impacts are largely associated with water quality (silt and hydrocarbons) as per earthworks on the wind farm. There will also be a number of bridge and culverts to be accommodated; two bridges and approximately 50 culverts have been identified along the route. Culverts vary in size and type from stone, concrete pipes and HDPE pipes. The bridges along the public road and Coillte road are shown in Plates 7-3 and 7-4, respectively. There is increased risk of water pollution while working in proximity to watercourses. The potential impacts will depend on the method used to install the cable over/under the river – i.e. cables are typically installed under the streambed or incorporated into the bridge structure over the river.

Plate 7-3: Bridge on Public Road Along Grid Connection Route

Plate 7-4: Bridge on Coillte Road Along Grid Connection Route

As noted, the grid connection route will follow roads for most of its length. Near the wind farm substation, it will cut across the field to soften the sharp turn at the junction. Horizontal directional drilling (HDD) will likely be used at the two bridge crossings and at one culvert (culvert No. 27 – triple culvert). While HDD is a less intrusive construction method than traditional open cut for crossing watercourses, there is the possibility of a 'frac out' (accidental release of drilling fluid) into the stream occurring, depending on the chosen technology. Release of drilling fluid or silts into the surface water environment would have a direct temporary slight negative impact on water quality and an indirect temporary slight to significant (depending on the presence of sensitive aquatic species) negative impact on habitats downstream. The grid connection works is not upstream of the surface water users identified near the wind farm.

- Fifty culvert crossing have been identified along the grid connection route. Of these, 24 No. appear to be of stone construction; some culverts are pipes, but with dry stone headworks. Where there is insufficient cover over the culvert, the ducting will need to be placed under the culvert. There is potential for the culvert to collapse, so they will need to be replaced before trenching at these locations. Therefore, minor instream works will be required, which if unmitigated could potentially release silt to the watercourse. Unmitigated, sediment loading presents a direct temporary slight negative impact on water quality locally; and an indirect short-term significant negative impact on habitats downstream of the site (e.g. if silt were to impact the sensitive aquatic habitats downstream of the site).
- Trenches may need to be dewatered prior to installing ducting and backfilling. This could occur due to the presence of groundwater or ingress of rainwater run-off. As the trenches will be shallow, the occurrence of groundwater is unlikely. The improper

disposal of this silt-laden water presents a direct temporary slight negative impact on water quality; an indirect short-term significant negative impact on habitats downstream of the site (e.g. if silt were to impact the sensitive aquatic habitats); and a brief to temporary imperceptible negative impact on users of surface water.

Operational Phase

There is less potential for direct and indirect impacts on surface water quality during the operational phase of the wind farm. There would be little or no earthworks, little or no concrete pours and comparably little hydrocarbons used or stored. The potential sources of surface water contamination during the operational phase are:

- Use of a back-up generator at the substation which would be fuelled from a storage tank (typically 1,300 litre capacity). There is potential for leaks or spills with the impacts similar to those of the construction stage.
- Oils and greases used in the maintenance of the turbines will be brought to site as needed and waste oils will be taken from site as they occur by the turbine maintenance contractor. The oils and greases are used in the equipment within the turbine, isolated from the environment, so do not present a risk to the surface water environment.
- Cooling oils are used in the grid transformer at the substation. Depending on the model, the grid transformer holds approximately 12,000L of cooling oil. These could leak / rupture, releasing oils into the environment. The oils need to be changed a few times over the lifetime of the transformer which presents an increased risk of leaks / spills. Unmitigated and depending on the volume released, hydrocarbons reaching the surface water environment would have a local direct temporary-short-term slight negative impact on water quality; an indirect temporary-short-term slight-significant negative impact on habitats downstream; and a temporary slight negative impact on users of surface water.
- There are no likely significant potential impacts on surface water or hydrology during the operational phase of the grid connection. It is possible that during the lifespan of the wind farm / grid connection, faults in the cable would necessitate repair or replacement of sections of the cable, but this would be done at the jointing bay locations. The fault location would be identified using non-intrusive techniques and the cable section replaced by accessing it at the two jointing bays either side. There would be a temporary localised imperceptible negative potential impact on surface water quality during the works.

Decommissioning Phase

The decommissioning of the wind warm would present similar potential impacts to those identified during the construction phase. The main potential impact is the pollution of water courses from silt and diesel. The return of the site to pre-construction conditions, with the removal of some roads, hardstands, substation and the turbines will result in a return to greenfield run-off characteristics. As noted in the Scottish Natural Heritage guidelines on restoration and decommissioning of wind farms it is '*best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm*'. It is likely that the grid connection and substation would remain, forming part of the National grid network.

7.4.3 Surface Water Run-off – Volumes & Rates

Construction Phase

The proposed development will progressively increase the hardstanding areas as roads, parking areas, construction compounds, and hardstands are constructed. The run-off characteristics of the hardstanding areas will be different to the greenfield site conditions. The changes in run-off are primarily associated with the operational phase. As noted in Section 7.2.3, the peatland hydrology has already been modified by the installation of man-made drains, and so less sensitive to changes from the wind farm construction than would otherwise be the case.

The run-off characteristics of the grid connection route will be largely unaltered. The cable trench will be restored with like-for-like material on an on-going basis.

Operational Phase

There is potential for direct and indirect impacts on the hydrology of the site and receiving waters during the operational phase. These are:

- The development footprint of the wind farm will extend to approximately 9.25ha. Table 7-8 summaries the areas of the site in each WFD sub-basin, the landbank area north of the public road in which the wind farm is located and the footprint area within each sub-basin – these catchments are shown on Figure 7-1. For a given rainstorm event the volume and rate of run-off could be increased due to the change in run-off characteristic and the installation of roadside drainage. An increase in run-off rates and volumes from the site, which, unmitigated, will be a long-term, intermittent (coinciding with heavy rainfall events), imperceptible-slight negative impact within the catchment.

- The proposed access roads cross several drains and streams. The main crossings are summarised in Table 7-9 and locations are shown on Figure 7-2. These streams and drains will need to be culverted. Inappropriate sizing of pipework or blockages could impede flows, particularly during heavy rainfall events. Local flooding or surface water ponding could result. Unmitigated, this would be a long-term, intermittent (coinciding with heavy rainfall events), imperceptible negative localised impact.
- During the operational phase, driving rain is intercepted by the tower and run-off is concentrated at the base of the tower. This is a long-term, intermittent, imperceptible negative localised impact.
- If backfilled with permeable material, cable trenches can potentially provide preferred pathways for water movement. This could lead to erosion of the trench backfill material, particularly on steeper slopes. It could also provide preferential movement for contaminants. Unmitigated, this would represent a long-term, not-significant negative localised impact.

Table 7-8: Summa ryof Sub-Catchment Areas

WFD Sub-Basin	Total Sub-Basin Area (ha)	Area of Sub-Basin within Wind Farm (ha)	Deve loped Area within Sub- Basin (ha)	Comments
Stran-agoppoge 010	1 ,829	367	3.74	Development in this WFD Sub-basin includes turbines T01 to T04. Percent of sub-basin developed = 1.02%
Stra-cashel 010	2 046	204	5.46	Development in this WFD Sub-basin includes turbines T05 to T08, substation and grid connection. Percent of sub-basin developed = 2.68%

Table7-9: Summary of Watercourse Crossings

Road Section / Crossing ID	Crossing Description	Photo
Entrance 1 to T01/T02 Junction – X1	Non-EPA stream. Channel is ~1.2m deep, 0.6m wide at base and ~2m wide at top of bank. Bottomless / clear-span structure recommended.	
T01/T02 Junction to T01 – X2	Non-EPA stream as per X1. ~2m deep, 0.4m wide at base and 4m across at top of bank. 600mm φ HDPE culvert suitable.	
T01/T02 Junction to T02 – X3	EPA stream. Shallow channel 0.3m deep and 0.3m wide. Has appearance of man-made drain 450mm φ HDPE culvert suitable.	
Approach to T02 – X4	Non-EPA stream. Channel is ~1m deep, 0.3m wide at base and 1.5m wide at top of bank. 450mm φ HDPE culvert suitable.	

Road Section / Crossing ID	Crossing Description	Photo
T03/T04 Junction to T03 – X5	EPA stream. Channel is 1.6m deep, 0.8 wide at base and 3 to 4m wide at top of bank. Bottomless / clear-span structure recommended.	
T04 to T05/T06 Junction – X6	EPA stream. Channel is 1.6m deep, 0.4 wide at base and 3m wide at top of bank. Bottomless / clear-span structure recommended.	
T04 to T05/T06 Junction – X7	EPA stream. Channel is 1.2m deep, 0.3 wide at base and 2m wide at top of bank. 600mm φ HDPE culvert suitable.	
Approach to T06 – X8	While this section is not shown as being an EPA stream (https://gis.epa.ie/EPAMaps/) it is noted that the EPA mapping is not correct. Channel is 1m deep, 0.3 wide at base and 1.5m wide at top of bank. 450mm φ HDPE culvert suitable.	

Road Section / Crossing ID	Crossing Description	Photo
Approach to T05 – X9	While this is an EPA stream, there is no defined channel. Water enters flat flush area from man-made drains and spreads with flows through grasses / rushes. 450mm φ HDPE culvert suitable.	
T05 to T07 – X10	Non-EPA stream. This is a field boundary drain. Channel is ~0.8m deep, 0.4m wide at base and 1.5m wide at top of bank. 450mm φ HDPE culvert suitable.	
T05 to T07 – X11	While an EPA stream, there is no well-defined channel at this crossing point. 450mm φ HDPE culvert suitable.	

Decommissioning Phase

The decommissioning of the wind farm would reverse impacts on hydrological aspects of the site in so far as they occur. The extent of this would depend on the final restoration plan. For example, it is likely that not all the roads would be removed, being used for forestry and farming purposes and the substation could remain, becoming part of the local ESB network.

7.4.4 Do Nothing Scenario

If the proposed wind farm is not constructed, it is likely that the current land use of rough grazing and commercial forestry will continue for the foreseeable future. It is possible that more of the landbank will be planted with commercial forestry.

7.4.5 Cumulative Impacts

The proposed wind farm is spread across two river catchments. There are no developments, existing or proposed, in the vicinity of the site that would result in any significant cumulative impacts.

7.5 Mitigation Measures for Surface Water

The mitigation measures proposed for the construction and operation of the wind farm have regard to the guidelines, consultation, site conditions, and sensitivity of the receiving surface water environment. As the receiving waters are sensitive (designated SACs and holding populations of protected species), maintaining the good water quality in the streams draining the site is the objective of the avoidance and mitigation strategy. The measures to protect the surface water quality are set out below. Greater detail, including method statements where appropriate, is provided in the CEMP (Appendix 7.4). The CEMP includes details of earthworks (Chapters 5 and 6, and Method Statement No 2 – Road Construction, Method Statement No 2 – Peat Management, Method Statement No 6 – Horizontal Directional Drilling and Method Statement No 7 – Grid Connection Construction Methodology, which provides additional detail on HDD). It also details Emergency Response Procedures for environmental incidents.

7.5.1 Surface Water Quality

Pre-Construction Ground Investigation

- Prior to mobilising to site for ground investigation trial pit excavations, the sequencing and route between locations will be designed to minimise stream crossings.
- A wide-track excavator will be used to minimise compaction of vegetation and peat along the route. The excavator will be power washed prior to mobilisation to site to prevent the spread of non-native invasive species.
- Where stream crossings are unavoidable, a crossing point will be selected where the excavator can cross the stream without disturbing the stream bed. As the crossing points

are narrow, this can be done at the Graffy site. This can be achieved by holding the front of the excavator clear of the channel with the bucket/arm and 'bridging' with the tracks. The rear of the machine is then held clear of the channel as the machine advances to the far bank.

- The material excavated from trial pits will be replaced back into the excavation in reverse sequence. Trial pits will be restored immediately after completion once all the necessary data and samples are collected. The surface vegetative layer will be placed right-way-up to restore the trial pit to original ground condition.
- For drilling, techniques will be preferentially selected where recirculating water is not required. For example, cable percussive (shell & auger) would be used. However, if drilling with water is required, the water will be recirculated in a contained basin. These basins are chambered metal containers or small lined ponds excavated near the drilling rig. Silt fencing / sandbags / straw bales will be erected between the stream and the drilling location to contain and spillages of silt-laden water. A double row of silt fencing will be erected between the drilling rig and the watercourse. On completion, drilling water will be slowly released into a percolation pit. If percolation is too slow, the drilling water will be collected and taken to a wastewater treatment plant. Used drilling water will not be released to drains.

<u>Construction Phase</u>

General Construction Mitigation

- During the construction phase, best practices will be employed to minimise the release of sediment laden storm water run-off.
- The developer will appoint an Environmental/Ecological clerk of works (ECoW) for the duration of the construction project. The ECoW will have an ecological and environmental management background with practical experience of wind farm construction projects. The ECoW will monitor the environmental aspects of construction (water quality, performance of surface water management infrastructure, etc.). The ECoW will have the authority to instruct the contractor to implement additional mitigation measures, if deemed appropriate. The ECoW will maintain a written record of all environmental issues on site, including incidents and monitoring results. This file will be made available to the relevant Authorities upon request. The

ECoW will be responsible for notifying the relevant Authorities of any environmental incident. The CEMP details the role and responsibility of the ECoW.

- Following mobilisation to site, surface water management infrastructure will be the first works carried out. Additional controls will be installed as needed as construction progresses through the site, and/or as identified during site inspections of surface water management infrastructure.
- Earthworks will be suspended during extreme weather conditions. An extreme rainfall event will be classified as an event that corresponds to the Met Éireann Orange – Weather Alert for rainfall. The ECoW will monitor the weather forecast to make preparations ahead of adverse weather conditions.

Met Eireann Orange – Weather Alert for Rainfall
50 mm – 70 mm in 24 hrs
40 mm – 50 mm in 12 hrs
30 mm – 40 mm in 6 hrs

- The public road serving the site will be kept clean of mud and debris so that silt is not washed to watercourses downstream of the site and outside the control of the wind farm development. If mud or debris is tracked onto the public road from vehicles leaving the wind farm site, the road will be swept.
- Chapter 8 of the CEMP details the Emergency Response Procedures for environmental incidents. This includes preparedness for such events, including training, responsibilities and maintain supplies on site for controlling environmental incidents (such as sandbags, straw bales, silt fencing, rip-rap etc.).

Road, Hardstand, Cabling & Turbine Construction

- Clean surface water runoff will be diverted around earthworks areas to minimise the potential volume of silted water generated. To achieve this, shallow cut-off drains or temporary plastic diversion barriers will be installed.
- Areas stripped of vegetation will be kept to a minimum. Areas along road verges and around hardstands will be reinstated / landscaped on an on-going basis as this infrastructure is constructed. Peat turves will be placed on the surface to expedite this restoration. Where peat turves are not available, restored areas will be seeded. This will reduce areas of soil exposed to erosion. It will also provide beneficial reuse the peat near its source.
- Stockpiled soils will be kept a minimum distance of 50m from any watercourse. Silt fences will be placed downgradient of stockpiles to treat any polluted run-off.

- Drainage swales will be constructed at track edges, as necessary, with discharge to existing forestry drains for sections of road within forestry (approximately 1.03km; 360m on site and 670m for the transport route upgrade). Forestry drains are partially clogged with pine needles, so water movement will be slow facilitating removal of silt and fines.
- For the 4.45km of new road on open hillside, run-off water will be directed to frequent break-out points on the downslope side of the road to achieve a more naturalistic overland flow pattern. Roads will have broad-based dips to force water from the road onto adjoining undisturbed peatland with sheet flow to existing natural flow paths.
- Check dams and / or straw bales will be installed along the alignment of roadside drainage to slow flows and remove silt. Check dams will be constructed using clean stone and geotextile spanning across the drainage channel.
- If required, dewatering of foundations will be to temporary silt traps. Flow from the silt traps will be diffuse. The water would travel overland and any silt would be settled before reaching the drains or streams. As noted in Chapter 6, dewatering of foundation excavations is not envisaged.
- The release of cement to water courses will be prohibited. Concrete pours will occur in contained areas, using shuttering. Rinsing down of concrete trucks will be done at dedicated locations on site. These will be located at a number of locations around the site. The rinse down areas will consist of a settlement pond (3.5m wide, 5m long and 1.2m deep – minimum dimensions), lined with terram and stone filter. This will have the capacity to hold enough water for the rinse down of 80 trucks using 150 litres per truck. Water will be able to percolate through the stone filter and terram while removing cement fines. These settlement ponds will not receive surface water run-off so capacity to receive rinse down water is always available. They will be located a minimum distance of 50m from any watercourse with water released to diffuse flow once pH has neutralised and confirmed by the ECoW. Signage will be erected at each concrete pour location directing drivers to the nearest rinse down area. These rinse down areas will be removed at the end of the construction phase.
- Clay plugs will be installed along the length of the cable trenches to eliminate these acting as preferential pathways. Clay plus will be more frequent on steeper section of the cabling routes.

Works near Watercourses

- Works on stream crossings will be carried out in dry weather as far as practical when low flows occur in the streams / drains. Although fish were absent during surveys at all new crossing locations, bridging of the larger streams will be achieved by clear-span structures – refer to crossings X1, X5 and X6. In-stream works will be kept to a minimum and will be avoided between 01 October and 30 April as per IFI and Loughs Agency guidelines. The IFI will be consulted for crossings wider than 600mm. Stream crossing design will have regard to the Fishery Board's guidance documents for road construction[2, 3].
- Drains will be culverted under roads using suitably sized pipework. Streams will be crossed with bottomless (clear span) structures. A minimum 450mm ϕ culvert will be used.

Fuel Storage & Refuelling

- Hydrocarbons (oils, diesel and chemicals) will be stored and managed in an appropriate manner to ensure no negative impacts. Specific measures will include:
    - Any storage of oils and diesel on site will be in steel or plastic tanks of good integrity and bunded to 110% of tank capacity. All fuel and hydraulic fluids will be stored in the site COSHH store located in the site compound.
    - Refuelling will be carried out directly from delivery vehicles. Refuelling of mobile plant will not take place within 50m of any sensitive receptor. Refuelling by mobile bowser may be used for small generators etc. Toolbox talks on refuelling will be given to delivery drivers in addition to plant operatives.
    - Fuels, lubricants and hydraulic fluids for equipment used on the construction site will be carefully handled to avoid spillage, properly secured against unauthorised access or vandalism, and provided with spill containment according to best codes of practice.
    - Any spillage of fuels, lubricants or hydraulic oils will be immediately contained, and the contaminated soil removed from the site and properly disposed of.
    - Waste oils and hydraulic fluids will be collected in leak-proof containers and removed from the site for disposal or re-cycling.

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[2] Department of Marine and Natural Resources, 1998. *Fishery Guidelines for Local Authority Works.*

[3] Southern Region Fisheries Board, June 2007. *Maintenance and Protection of the Inland Fisheries Resource during Road Construction and Improvement Works – Requirements of the Southern Regional Fisheries Board.*

- Appropriate spill control equipment, such as oil soakage pads, will be kept in the site plant to deal with any accidental spillage. Spare spill kits will be kept at the construction site compound.

Tree Felling & Replanting

- Keyhole felling of trees for road construction will follow Forest Service Forestry and Water Quality Guidelines and Forest Harvesting and Environmental Guidelines.
- A suitable alternative off-site location has been identified for replacement tree planting. The site is in Sonolaun and Kilmovee townlands in County Mayo. An area of 6.82ha has technical approval for planting from Forest Service – contract number CN78721 refers.

Grid Connection

Mitigation measures to be employed during the trenching for the grid connection include:

- The trenching for the grid connection will be done in short sections minimising the amount of disturbed ground and soil exposed to run-off. Each section of trench opened will be completed (ducting installed and backfilled) by the end of each working day.
- The section of trenching to be completed each day will be inspected and surface water protection measures put in place prior to excavation works commencing. This will include placement of sandbags to protect existing roadside drains, placement of sandbags to direct road run-off from the works area, erecting silt fencing where appropriate, locating culverts to be crossed that day, etc.
- Surplus excavated material will be loaded directly into trucks and taken off site to an authorised waste recovery facility. Where the material encountered is suitable for reuse as backfill, it will be placed on the upgradient side of the trench so that any rainfall run-off (carrying silt) will be into the trench.
- Concrete truck rinse down will not be carried out along the grid route. This will be done at the batching plant.
- In the unlikely event that trenches need to be dewatered, a vacuum tanker will be used. The water will be taken to the wind farm site and discharged into an on-site settlement pond. The water will be released into a drain leading to the pond at a rate that doesn't exceed the design parameters of the pond, to ensure the water is sufficiently treated to remove silt. Due to the extremely high value of the receiving surface water environment, water will not be pumped from trenches to the roadside drains.

- Where replacement of existing stone culverts is required, the following mitigation will be used:
    - Works will be supervised by the ECoW and / or the project aquatic ecologist who will liaise with IFI and National Parks and Wildlife Service (NPWS) prior to works commencing. The ECoW will also monitor surface water quality downstream of the works in accordance with the surface water monitoring programme and will have the authority to cease any works should the monitoring identify unacceptable water quality conditions.
    - Any works within watercourses that have the potential to support fish (indicated in Chapter 10(iv) as being at least of "Medium" sensitivity), will be avoided between 01 October and 30 April as per IFI and Loughs Agency guidelines.
    - All plant and equipment will be serviced and cleaned before entry to site to limit risk of oil spillage and for biosecurity.
    - Where temporary fluming or flow diversion is proposed in a watercourse with salmon or trout present (at least Medium sensitivity) all fish within the designated area will be subject to fish rescue and translocation downstream by a fisheries biologist. Fish rescue will be conducted under Section 14 authorisation (DCCAE/ IFI) or Section 69 authorisation (Loughs Agency) where appropriate.
    - Works will be carried out in dry weather with low flows in the streams with forecast for dry weather for the duration of the works – approximately 2 days.
    - Machinery used will stay on the public road; machinery will not be permitted to enter the stream channel.
    - The road edge adjacent to the watercourse will be lined with sandbags and silt fences (multiple fences recommended) as appropriate to prevent run-off from the trenching works reaching the stream. The design of these multiple features shall also allow for the safe removal of accumulated silt away from the channel, particularly through staged removal of the most contaminated upper fence before the lower ones, and the removal of the final fence only when it is clear of any silt
    - Clean sandbags will be used to dam flows on the upstream side of the culvert. Sandbags will be placed by hand at a suitable location to take advantage of any natural pool but set back from the works to permit unhindered excavation of the existing culvert.

- A second sandbag dam will be placed on the downstream side of the culvert to prevent backflow into the works and contain any groundwater seepage that is likely to be turbid.
- Sandbagging requires careful attention to detail if it is to be effective. All bags must be laid neck uppermost and seams aligned. Bags must not be overfilled or they will not tamp together or will burst with ease. Additional bags will be filled ready to raise freeboard of dams.
- Flume placement for temporary flow diversion or permanent replacement of culverts will follow guidelines issued by IFI and CIRIA to ensure that fish passage is not impeded.
- If topography permits, the water will be piped over the road by gravity flow, otherwise, it will be pumped. Discharge will be via break tank or similar approved storage onto a splash-plate or rip-rap (gabion basket) to dissipate energy and avoid scour or erosion of the stream bend or banks. The pump will be filled with a screen, so fish aren't drawn into the pump intake.
- The use of pump sumps will be considered within the dammed area. These will be lined to prevent scouring. The intention is to intercept clean groundwater ingress and pump it out rather than allowing it to get silted in the works area by segregating off areas.
- Any spoil generated will be removed to designated safe area clear of the flood plain. Some of this spoil will be saturated and will require bunding and sheeting over.
- If bank material needs to be removed it will be stored separately and reinstated according.
- The ducting will be advanced passed the culvert and the existing culvert will be excavated 'in the dry' and a new culvert, sized for a 100-year rainstorm event, will be installed with appropriate gradient, headworks and outfall. A precast concrete culvert, concrete pipe or HPDE pipe will be used. Culverts will be embedded to at least 300mm below the existing stream bed to ensure backwatering. Culverts will avoid a significant change in gradient (i.e. >3%). After embedding, replacement culverts will be filled with clean washed gravels and cobbles to replace lost habitat and facilitate fish movement.

  - Dry stone headworks will be placed at the culvert intake and discharge and the stream bed adjacent to the works will be reinstated at the direction of the project aquatic ecologist.
  - The ECoW will determine the quality of any water trapped between the two dams – visual inspection and turbidity meter. If this water is clean, it will be left in situ. If it is not clean, it will be removed from the works area prior to removal of the dams. If required, dewatering of the works area prior to dam removal will be undertaken by pumping from the stream bed to either a) the cable trench for percolation or b) taken back to the wind farm site for treatment at an existing settlement pond or c) treatment using a Siltbuster. The most efficient method will depend on the volume of water present and the available percolation.
  - The upstream dam will then be removed to permit flow though the new culvert. This will be done in phases, so a large volume of water isn't released at once. The downstream dam will be removed in a similar manner.
- The two bridges along the grid connection route have been inspected by the specialist contractor and it confirms that HDD is the most appropriate ducting installation method at these two locations and at a third location (triple culvert).
- For directional drilling, a specialist contractor will be engaged. The HDD contractor will provide a site-specific method statement for this work. It will incorporate the measures detailed in the CEMP, including emergency response plan, and the following measures:
  - The setback distances from the watercourses at the three HDD locations (i.e. the launch and exit pits) will be 50m, 20m and 25m for the Coillte Bridge, public road bridge and triple culvert, respectively.
  - As rotary drilling techniques are required, drilling fluid will be required. A materials safety data sheet (MSDS) for the drilling fluid will be provided to, and approved by, the ECoW prior to works commencing.
  - Measures to protect the watercourse will be erected before commencement of drilling. This will include silt fencing, sandbags and straw bales. Additional materials will be on hand in the event of a frac-out – refer to Appendix B in the TLI report included in Attachment 7 of the CEMP for the 'frac-out' mitigation plan.

- Operations will to be limited to daytime hours and conditions when low levels of rainfall are forecast.
- The depth of the bore shall be a safe depth (minimum 2.5m) below the bed of the watercourse.
- The ECoW will monitor, or arrange for monitoring, drilling operations at all times.

7.5.2 Surface Water Run-off – Rates & Volumes

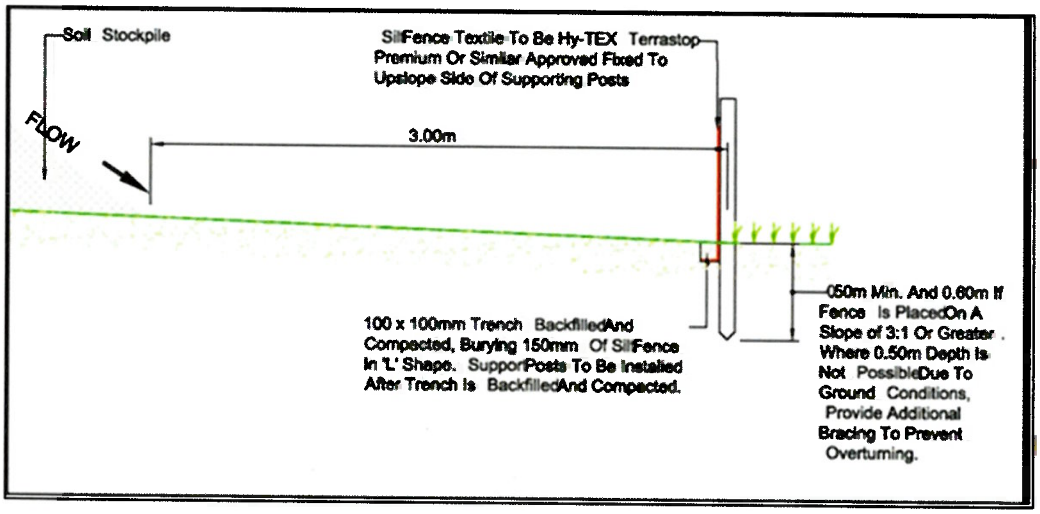
The wind farm will be constructed to mimic as far as possible the greenfield run-off characteristics of the site during its operation. Specific design measures and site management are:

- As noted above, drainage swales will be constructed at track edges with discharge to existing forestry drains for sections of road within forestry and for new roads, run-off water will be directed to frequent break-out points on the downslope side of the road to achieve a more naturalistic overland flow pattern. Roads will have broad-based dips to force water from the road onto adjoining undisturbed peatland with sheet flow to existing natural flow paths.
- The road and hardstanding areas will be constructed with aggregate – there will not be a hard-paved surface. This will reduce run-off volumes.

7.5.3 Infrastructure for Surface Water Management

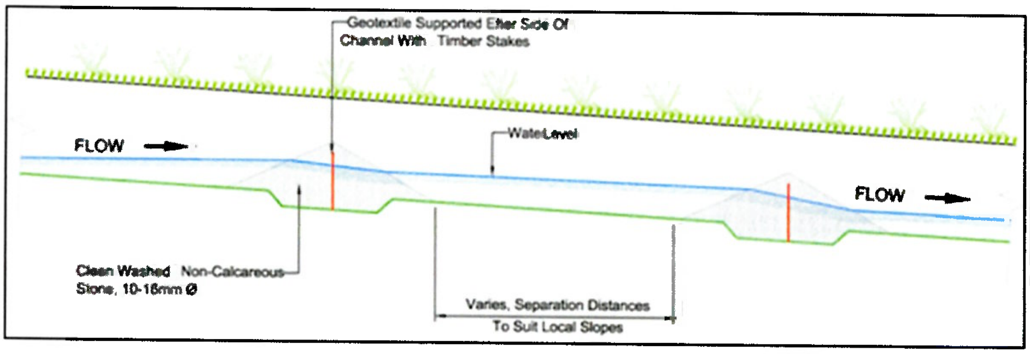
The infrastructure to be used to manage and treat surface water, and to control erosion at the wind farm construction site are:

1. To reduce the volume of water to be treated during construction and to reduce the erosion potential of exposed peat and soils, clean surface water run-off will be diverted around earthworks areas. This will be done with the use of diversion barriers/channels. Diversion channels are shallow interceptor drains, while barriers are made of a stiff, but flexible, plastic (HDPE or LDPE) material approximately 0.3m high that is inserted vertically (50 to 100mm) into the peat/ground surface to divert overland flows. The barrier is supported with wooden pegs.
2. Silt fences will be erected on the downslope side of any earthworks areas to intercept any overland flows that could potentially be carrying silt / fines. These are constructed with geotextile embedded in the peat and supported with wooden pegs. See example below.

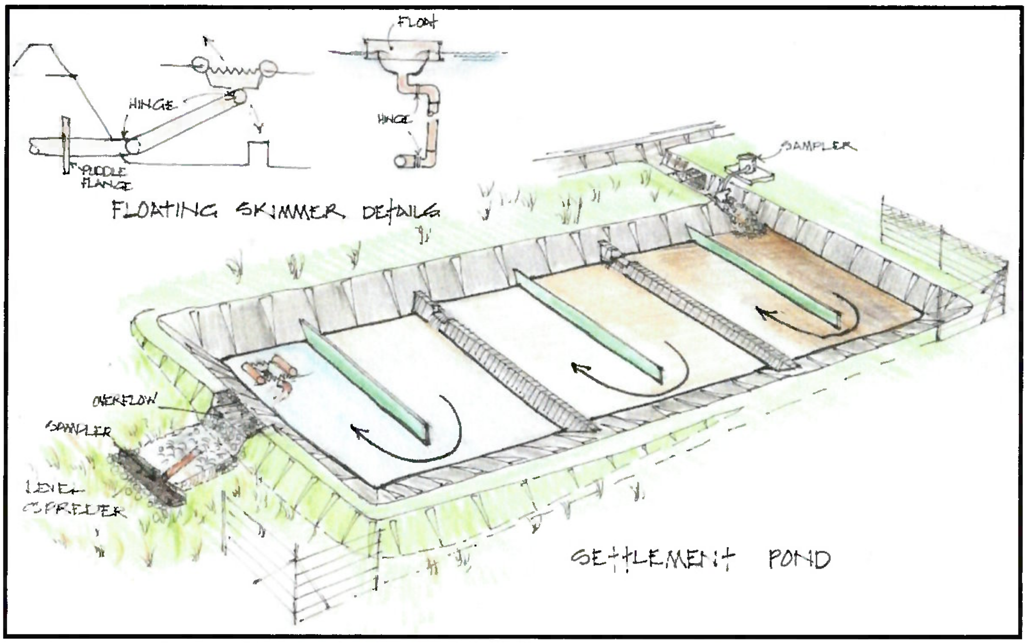


Double rows of silt fences will be used for works nears (within 10m upgradient) of a water course.

3. Where convention road construction is used, check dams will be installed at frequent intervals along the roadside drainage channels. These will be constructed using geotextile supported by two wooden pegs, sandwiched by clean washed filter gravel, as illustrated. Straw bales may also be used.



4. Use of settlement ponds at the turbine locations. Water pumped from the foundation excavation or run-off from the works area will, where necessary, be directed to a settlement pond to remove silt and fines. The flow from the settlement ponds will be diffuse overland flow. An example is shown below.



The settlement ponds have been sized to treat run-off for a 60-minute storm duration with a 10-year return period. Calculations are provided in Appendix 7-3. The size of the pond is driven by settlement of the clay particles. Additional settlement will be achieved within each pond with the installation of a forebay, internal stone filters and decanting of water from the surface of the pond. Furthermore, discharge from the ponds will be to a level spreader for overland flow downslope through vegetated areas; there will not be direct discharge to watercourses from the settlement ponds.

Plate 7-5 shows examples of the surface water management infrastructure used in wind farm construction, including 3-chamber silt pond, road-side drainage check dam, flow barrier and clean water diversion channel.

Plate 7-5: Surface Water Management Features

7.5.4 Site Specific Water and Sediment Management

The specific surface water management and sediment control for each turbine location, substation and construction site compound are provide below. This infrastructure is illustrated in Figure 7-3 to 7-13.

Turbine T01

Turbine T01 is located on the eastern side of the site within commercial forestry. There is a flattish shelf with rock outcrop rising above the northern side of the hardstand which will need to be lowered (i.e. rock breaking). Peat is shallow across most of the works area. There is a stream crossing to be accommodated on the approach to T01, crossing X2 in Table 7-9. The surface water management will consist of:

- A cut off trench / diversion barrier along the northern perimeter of the earthworks area. This will send run-off water to the east of the turbine.
- A silt fence will be erected to the east of the works area, between the works area and erosion gulleys.
- A silt fence will be erected along the southern perimeter of the earthworks area.
- A settlement pond will be constructed at the south side of the hardstand. Run-off water from the earthworks area will be collected and treated before discharge to overland flow paths.

Turbine T02

Turbine T02 is located on a relatively flat area of semi-improved grassland. There is a non-EPA stream (crossing X4 in Table 7-9) on the approach to the turbine along with shallow man-made drains. The surface water management will consist of:

- A cut off trench / diversion barrier along the northern perimeter of the earthworks area. This diversion will direct overland flow to the west towards a man-made drain.
- A silt fence will be erected to the east of the works area, between the works area and the non-EPA stream.
- A silt fence will be erected along the western and southern perimeters of the earthworks area.
- Due to the proximity of drainage channels in this area, a settlement pond will be installed near the southwest corner of the hardstand. Discharge will be to a level spreader to promote overland flow.

Turbine T03

Turbine T03 is located adjacent to commercial forestry; there is commercial forestry to the west. There is a flattish shelf with rock outcrop running along the northern and southern perimeters of the hardstand. Peat is shallow across the western side of the hardstand but deepens towards the eastern end of the hardstand. There is an EPA stream to the north of the turbine location but is separated from it by a low ridge; the turbine is not within the stream catchment. There is a second EPA stream to the west of the turbine, running along the forestry boundary. Again, the turbine is not within the direct catchment of this stream. There is a non-EPA stream crossing to be accommodated on the approach to T03. This is a narrow channel flowing across bedrock. The turbine is in the catchment of this stream, which joins with the second stream approximately 300m to the southeast of the turbine. The surface water management will consist of:

- Clear demarcation of the surface water divide for the stream to the north of T03. Apart from the cabling connection, no works are to be carried out beyond (north of) this divide.
- A cut off trench / diversion barrier along the northern and western perimeters of the earthworks area.
- A silt fence will be erected to the east and south of the works area.

As run-off will be sheet flow from the works area, which will be treated with silt fences, it is not envisaged that a settlement pond will be needed at this location. The sheet flow will travel >100m before reaching any drains.

Turbine T04

Turbine T04 is in improved grassland within the curtilage of a former residence. There is commercial forestry approximately 150m to the west and north. This is a reasonable flat area with a number of man-made drains in the area, one running through the handstand. Peat is shallow across the works area. The surface water management will consist of:

- Diversion of the man-made drain that flows through the western side of the cranage area. This will be diverted to the east, so it also acts as a clean water interception channel. It will be directed to an existing man-made drain located to the east of the hardstand.
- A silt fence will be erected to the southwest, south and east of the works area.
- Check dams will be installed in the existing drains in this area of improved grassland to the south of the turbine location.
- Due to the proximity of man-made drainage channels in this area, a settlement pond will be installed near the southwest corner of the works area. Discharge will be to a level spreader to promote overland flow.

Turbine T05

Turbine T05 is in a flat area to the north of commercial forestry. The topography rises sharply to the north of the hardstand, requiring rock breaking along this northern perimeter. Peat is shallow on the western and northern perimeters of the works area and deepens to approximately 1m towards the eastern side of the works area. There is an EPA stream to the east of the turbine location, but there is no defined channel; flows from the steep terrain to the northwest spreads out in the flat terrain and flow is through the dense vegetation (reeds and grasses). This stream (referred to as Tributary 6 in Chapter 10(iv)) has been assessed by the aquatic ecologist and found to have Poor ecological quality, very poor physical habitat quality, fish absent and so has a low sensitivity. There is a man-made drain to the west of the hardstand, separated by a sod & stone ditch. There are also a number of small man-made drains on the western side of the hardstand which drain to the forestry to the south. The surface water management will consist of:

- A cut off trench / diversion barrier along the northern perimeter of the earthworks area. This will send most of the run-off water to the man-made drain to the west. Some will be diverted to the existing drainage channels feeding into the EPA stream to the east of T05.

- A silt fence will be erected to the south and east of the works area. A second row of silt fence will be erected further south closer to the stream.
- Due to the proximity of drainage channels in this area, a settlement pond will be installed near the southeast corner of the hardstand. Discharge will be to a level spreader to promote overland flow.

<u>Turbine T06</u>

Turbine T06 is in a flattish area to the west of commercial forestry. The topography rises sharply to the north of the hardstand, requiring rock breaking along this northern perimeter. Peat is generally shallow (<1m typically) across the works area footprint. There is an EPA stream to the east of the turbine location. There is a second EPA stream shown crossing the southwest corner of the hardstand. However, the EPA mapping is not correct and the stream flows south before reaching the hardstand. The correct stream route is shown in Figure 7-6; refer to stream crossing X8 in Table 7-9. The two streams join before entering the forestry below turbine T06. These streams (referred to as Tributary 6 in Chapter 10(iv)) have been assessed by the aquatic ecologist. North of the public road the channel runs through a forest ride; the channel is incised with poor habitat quality as the cobble and pebble substrate is covered by a thick orange/ brown sludge layer. Most of the reach is unclassified with some areas approaching grade 3 nursery. Above the forestry and passed turbine T06, the channel narrows further and is largely unclassified habitat unsuitable for trout; there is very low fisheries potential above the public road. There is a man-made drain running through the centre of the hardstand, following a sod & stone ditch. A short section of man-made drain is located to the south of the turbine and flows to the east. The surface water management will consist of:

- A cut off trench / diversion barrier along the northern perimeter of the earthworks area. This will send the flow from the man-made drain and sheet flow to the east to the stream.
- A cut off trench / diversion barrier along the north-western perimeter of the earthworks area. This will send sheet flow to the west to the stream on the western side of the hardstand.
- A double row of silt fences will be erected along the south-western and south-eastern perimeters of the works area.
- A silt fence will be erected around the hammerhead works area.

- A series of check dams will be installed in the man-made drain to the south of the turbine.
- Due to the proximity of the turbine to the stream, a collection sump will be installed just east of the turbine location. All flows from earthworks areas will be intercepted and directed to the collection sump. Topography will necessitate pumping of the water from the collection sump to a settlement pond with discharge to a level spreader to the south of the turbine location.
- When constructed, the hardstand will be cambered so it drains directly to the settlement pond.

<u>Turbine T07</u>

Turbine T07 is in a flattish area with a low rocky ridge running through the southern side of the handstand. The topography rises sharply from the northern perimeter of the hardstand. Between the two, there is a narrow peat basin with peat depths up to 3.7m. There are no streams or drains in the immediate area; drainage is by sheet flow. There is a field boundary drain to the west of the works area. The surface water management will consist of:

- A cut off trench / diversion barrier along the northern perimeter of the earthworks area. This will send the flows mostly to the west, but some flows will go to the east.
- A silt fence will be erected along the southern perimeter of the works area including the hammerhead turning area.

As run-off will be sheet flow from the works area, which will be treated with silt fences, it is not envisaged that a settlement pond will be needed at this location. The sheet flow will travel >200m before reaching any drains

<u>Turbine T08</u>

Turbine T08 is in a flattish peat basin with low rocky ridges to the south and west. There are no EPA streams in the immediate vicinity of the turbine. There is a man-made drain flowing along the ditch at the approach to the hardstand. Man-made drains from the peat basin flow into this drain. The drain follows the ditch to the southeast before turning southwest and joining an EPA stream approximately 150m to the south of the turbine. A second drain flows from the southwest corner of the peat basin. Where it meets the first drain, it is identified as an EPA stream. Peat depth around the perimeter of the works is shallow (<0.5m) and deeper in the centre of the hardstand (approximately 1m). The surface water management will consist of:

- A cut off trench / diversion barrier along the northern perimeter of the earthworks area. This will send the flows mostly to the west, but some flows will go to the east.
- Check dams will be erected in the drains.
- A silt fence will be erected along the western and southern perimeters of the works area.
- Due to the proximity of drainage channels in this area, a settlement pond will be installed near the southwest corner of the hardstand. Drainage will be brought away from the man-made drain so sheet flow can be accommodated. Discharge will be to a level spreader to promote overland flow.

Substation & Construction Site Compound

The substation is in flattish improved grassland, at a surface water divide. Topography steepens to the south. There is an EPA stream flowing west approximately 25m to the north of the substation. Most of the works area is in its catchment. There is a shallow drain (swale) running through the substation footprint with flows to the north. Peat depth in the footprint of the substation is typically less than 1m. Deeper peat is found to the northwest of the substation. There is a roadside drain flowing to the north at the site entrance. A second roadside drain flows to the south. The surface water management will consist of:

- A cut off trench / diversion barrier along the eastern perimeter of the earthworks area. This will send the flows mostly to the south, but some flows will go to the north.
- A silt fence will be erected along the northern and western perimeters of the works area to protect the stream to the north. It is noted that the substation will be in cut along most of the northern perimeter, so once excavations commence, flows will be to the south. A second row of silt fence will be erected near the stream.
- Check dams will be installed in the drains near the entrance.
- A silt fence will be erected along the southern perimeter of the works area.
- Due to the proximity of streams and drains in this area, a settlement pond will be installed near the southwest corner of the substation. Discharge will be to a level spreader to promote overland flow

Arrangements at Stream Crossings

There are several stream / drain crossings to be installed for the wind farm access roads. The main locations are shown on Figure 7-2 and Table 7-9. Crossings and culverts will be installed during low flow conditions. Works will be restricted to between May and September for crossing X2, and preferably all crossings will be installed during this period. While the topography and ground conditions are specific to each location, these general surface water management controls will be implemented.

- A double row of silt fences will be erected along both banks of the water course, extending beyond the length of the crossing / culvert structure.
- Clean water diversion barriers will be installed on one or both sides of the watercourse, as appropriate. It may be the case that the crossing is being installed just in advance of road construction, in which case diversion barriers are only likely to be needed on the far side of the watercourse.
- For clear span structures,
    - Works will be carried out outside the silt fence.
    - Flows will be brought through the works area with temporary flume held in place with sandbags (filled with clean sand/fine gravel). Sandbags will also be used to direct flows into the flume.
    - Soft ground will be cleared and removed from the stream bank to construct the foundation for the structure.
    - Formwork will be installed, and the concrete foundation poured.
    - The precast clear span structure will be lifted into place and secured. Large stone headworks will be placed at the outer edges of the structure.
    - Soft / unsuitable soil will be removed between the structure and road, if necessary. Suitable fill material placed and compacted to the bridge abutments.
    - The temporary culvert and sandbags will be removed to allow flows on the natural streambed through the structure.
    - Exposed soil / peat will be seeded or covered with peat turves.
    - The silt fences will remain in place until the vegetation is established.
- For smaller crossings, culverts will be used. Minimum size will be 450mm ϕ. There installation will follow this general sequence:
    - During low flow conditions, any large loose rocks will be removed by hand from the channel.

- o The culvert pipe will then be placed in position to follow the nature slope of the channel bed.
- o Sandbags will be placed at the headworks, so flows are channelled into the culvert.
- o Large stone headworks will be placed at the outer edges of the pipework.
- o Soft / unsuitable soil will be removed between the culvert and road, if necessary.
- o A geotextile will be laid over the culvert and suitable fill material placed and compacted in layers. Additional geotextile will be used to prevent fines from being washed out.
- o Exposed soil / peat will be seeded or covered with peat turves.
- o The silt fences will remain in place until the vegetation is established.

Operational Phase

Mitigation measures to be employed during the operation phase of the wind farm are:

- To mimic as close as possible greenfield run-off rates and volumes, permeable finishes on roads and hardstands will be used. Break-out points will be provided along the length of the roadways to send water onto the hillside to its natural drainage pathway; water will not be delivered to drains / streams from long sections of new roads.
- Vegetation will be allowed develop in the roadside drains. This will slow flows and reduce erosion potential.
- Site drainage will be inspected and maintained during the lifetime of the wind farm. Culverts will be cleared of debris, so blockages do not occur. These tasks will be included in the contract for the wind farm operator.
- Rainfall concentrated at the turbine towers will be collected and discharged to a level spreader downhill from the turbine.

7.6 Worst-Case Scenario

The worse-case scenario would be if there was a release of silt-laden water or peat landslide into the streams draining the site during construction. As detailed in Section 6.4.4 and 6.6.1, the overall conclusion is that a peat landslide occurring is unlikely and the indicative risk level is negligible. Release of silt into streams could result in impacts on water quality, aquatic habitats, and aquatic fauna downstream of the event. With the implementation of the mitigation measures, inspections, and monitoring, the risk of this occurring is extremely low.

In the very unlikely event of this occurring, the following emergency response will be implemented. The full emergency response procedure will form part of the Site-Specific Health & Safety Plan and is included in Chapter 8 of the CEMP. An outline is given below:

1. Safety of site personnel and any potentially affected neighbours will be checked as a priority and appropriate action taken.
2. The appropriate authorities will be notified. This will include the County Council Environment Section, Inland Fisheries Ireland, etc
3. The ECoW will assess the situation and carry out a risk assessment to inform the appropriate mitigation to be undertaken. The priority will be to prevent any further release of silt-laden water.
4. Remedial works will be carried out at the location of the incident. The rest of the wind farm site will be inspected, and similar remedial works carried out where appropriate.
5. Surveys of the affected water course will be carried out and remedial measures carried out, where possible.

7.7 Monitoring

The ECoW will undertake weekly inspections at all outfalls from the construction works.

The ECoW will be responsible for monitoring water chemistry at the agreed monitoring points in the streams and rivers draining the site, as shown on Figure 7-2. Table 7-10 summarises the proposed monitoring regime. In addition, turbidity meters will be installed at discharge points from the site to continuously monitor water quality. Automated monitoring of surface water quality will be carried out prior to, during and post construction. This system will notify the ECoW if turbidity exceeds 75% of the emission limit value.

All samples collected will be input to a database and compared to baseline monitoring data. In the event of levels being identified which are outside of the baseline or above applicable guideline or legislative values an investigation will be undertaken.

It is also proposed to establish the site-specific relationship between turbidity values and TSS to allow real-time assessment of water quality at the ponds' inlets. Field measurement of turbidity will be taken at the pond inlets and samples of that water will be sent for TSS analysis. Once a sufficient number of samples have been collected, it will allow the relationship between turbidity and TSS concentration to be established. The 1,000mg/l TSS trigger value will then have an equivalent turbidity value, which can be measured in the field allowing for immediate action to be taken (i.e. the pond shut off), if required.

Automated turbidity monitors will be installed at four key locations on the streams draining the site. These will send SMS alerts if the emission limit value for the site is exceeded, notifying the ECoW. The emission limit value will be set at a turbidity value equivalent to 20mg/l; establish based on sampling and analysis as described above. An investigation will be carried out in the event of an exceedance occurring. It should be noted that turbidity fluctuates naturally with the stage of the river, higher values occurring during high flow events, so alerts may not necessarily be attributed to on-site works.

Table 7-10: Surface Water Quality Monitoring Plan

Monitoring Location	Monitoring Frequency	Monitoring Programme	Parameters
WQ1 to WQ10	Monthly	Starting 1 month prior to construction and continuing for the duration of construction.	Apparent Colour, TSS, Nitrate, Nitrite, Total Oxidised Nitrogen, Ortho-Phosphate, Ammoniacal Nitrogen, Turbidity, BOD, Free Ammonia, Total Phosphorus & TPH
WQ3, WQ5, WQ8 and WQ9	Continuous monitoring	Starting 1 month prior to construction and continuing for the duration of construction.	Turbidity with SMS alarm capability
WQ1 to WQ10 & All Settlement Pond Discharge Points	Weekly or Daily Depending on Site Activity	During and following periods of rainfall, concrete pouring, daily inspection will be carried out.	Visual inspection, turbidity measurement and TSS.
All Settlement Pond Discharge Points	Daily	During / following periods of heavy rainfall, daily inspection will be carried out.	Visual inspection.

Monthly samples will be submitted to an accredited laboratory for analysis. Test results will be maintained on site and available for inspection by Council and Inland Fisheries Ireland staff.

In addition to the above, water quality will be monitored upstream and downstream of each stream crossing along the grid route as set out in Table 7-11.

Table 7-11: Surface Water Monitoring for Grid Connection

Monitoring Location	Monitoring Frequency	Monitoring Programme	Parameters
Upstream & Downstream of the grid crossing of all EPA-designated streams (20 No.)	Weekly	Starting 1 month prior to construction, continuing for the duration of construction and one month after completion of the works.	Field measurement of pH, temperature, conductivity, TPH, DO & turbidity

Monitoring Location	Monitoring Frequency	Monitoring Programme	Parameters
	Weekly or Daily Depending on Site Activity	During and following periods of rainfall, daily inspection will be carried out at all river crossings where works have been, or are bein g,carried out.	Field measurement of pH, temperature, conductivity, TPH, DO & turbidity

All data collected will be input to a database and compared to baseline monitoring data. In the event of levels being identified which are outside of the baseline; downstream results are significantly different to upstream results; or above applicable guideline or legislative values, an investigation will be undertaken. Monitoring data will be maintained on site and available for inspection by Council and Inland Fisheries Ireland staff.

7.8 Conclusions on Surface Water

The hydrology of the site is typical of an upland area. The impacts on hydrology and surface water have been identified and assessed. Where impacts have been identified, mitigation measures will be implemented to avoid or reduce the risk of impacts occurring. On balance, the wind farm can be constructed and operated with no significant impact on the surface water environment.

8. AIR QUALITY

Table of Contents

AIR QUALITY AND CLIMATE ASSESSMENT
GRAFFY WIND FARM

Rp004 2019162 (Graffy WF)
17 May 2021

PROJECT: GRAFFY WF

PREPARED FOR: CUILFEACH TEORANTA
1ST FLOOR MCKENDRICK PLACE
PEARSE ROAD
LETTERKENNY
COUNTY DONEGAL

ATTENTION: NOEL MCDERMOTT

REPORT NO.: Rp 004 2019162

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8.1 INTRODUCTION

Irwin Carr Ltd have been commissioned by Cuilfeach Toeranta to assess the air quality and climate impact from the proposed Graffy Wind Farm near Glenties, Co. Donegal, and associated grid and haul proposals. The proposed wind farm will comprise of eight turbines with a hub height of 84m and a rotor diameter of 132m.

It is understood that this report will be submitted for assessment by Donegal County Council, or/and An Bord Pleanala, as part of a comprehensive Environmental Impact Assessment Report.

The windfarm will supply the power generated to the National Grid and on completion will have an installed capacity of approximately 32 MW.

8.1.1 Air Quality Standards

The European Union (EU) has introduced several measures to address the issue of air quality management, since the initial Framework Directive on ambient air quality assessment and management (Council Directive 96/62/EC). The aim is to protect human health and ecosystems from negative impacts.

The current guidelines are the Clean Air for Europe (CAFÉ) Directive (2008/50/EC) which replaced the previous Air Framework Directive (1996/30/EC) and its daughter directives. The air quality standards currently applicable in Ireland are the EU ambient standards, which are presented in Table 1 below. These limits were transposed into Irish law by the S.I. No.180 of 2011, Air Quality Standards (AQS) Regulations 2011

The concern from a health perspective is focussed on particles of dust which are less than 10 microns. EU ambient air quality standards centres on PM_{10} (particles less than 10 microns) as it is these particles which have the potential to be inhaled into the lungs and potentially cause adverse health impacts. The Directive also sets an ambient standard for $PM_{2.5}$ (particles less than 2.5 microns and form part of PM_{10}) which came into force in 2015.

Table 1: Irish Air Quality Standards

Pollutant	Directive / Regulation	Limit Type	Value
Nitrogen Dioxide	2008/50/EC and SI180 of 2011	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 µg/m^3 NO_2
		Annual limit for protection of human health	40 µg/m^3 NO_2
		Annual limit for protection of vegetation	30 µg/m^3 NO + NO_2
Sulphur dioxide	2008/50/EC and SI180 of 2011	Hourly limit for protection of human health - not to be exceeded more than 24 times/year	350 µg/m^3
		Daily limit for protection of human health - not to be exceeded more than 3 times/year	125 µg/m^3
		Annual Mean	60 µg/m^3
Particulate Matter (as PM_{10})	2008/50/EC and SI180 of 2011	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 µg/m^3 PM_{10}
		Annual limit for protection of human health	30 µg/m^3 PM_{10}
$PM_{2.5}$	2008/50/EC and SI180 of 2011	Annual limit for protection of human health	25 µg/m^3 $PM_{2.5}$
Benzene	2008/50/EC and SI180 of 2011	Annual limit for protection of human health	5 µg/m^3
Carbon Monoxide	2008/50/EC and SI180 of 2011	8-hour limit (on a rolling basis) for protection of human health	10 mg/m^3

The standards for air pollution set out above are concentrations over a given time period that are considered to be acceptable in the light of what is scientifically known about the effects of each pollutant on health and on the environment. They can also be used as a benchmark to determine if air pollution is getting better or worse.

An exceedance of a standard is a period of time (which is defined in each standard) where the concentration is higher than that set down by the standard. In order to make useful comparisons between pollutants, for which the standard may be expressed in terms of different averaging times, the number of days on which an exceedance has been recorded is often reported.

An objective is the target date on which exceedances of a standard must not exceed a specified number.

8.1.1.1 GOTHENBURG PROTOCOL

In 1999, Ireland signed the Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution. The initial objective of the Protocol was to control and reduce emissions of Sulphur Dioxide (SO_2), Nitrogen Oxides (NO_X), Volatile Organic Compounds (VOCs) and Ammonia (NH_3).

To achieve the initial targets Ireland was obliged, by 2010, to meet national emission ceilings of:

- 42kt for SO_2 (67% below 2001 levels)
- 65kt for NO_X (52% reduction)
- 55kt for VOCs (37% reduction)
- 116kt for NH_3 (6% reduction).

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:

- 25kt for SO_2 (65% below 2005 levels)
- 65kt for NO_X (49% reduction)
- 43kt for VOCs (25% reduction)
- 108kt for NH_3 (1% reduction)
- 10kt for $PM_{2.5}$ (18% reduction).

COM (2013) 917 Final is the "Proposal for a Council Decision for the acceptance of the Amendment to the 1999 Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution to Abate Acidification, Eutrophication and Ground-level Ozone".

European Commission Directive 2001/81/EC, the National Emissions Ceiling Directive (NECD), prescribes the same emission limits as the 1999 Gothenburg Protocol. A National Programme for the progressive reduction of emissions of these four transboundary pollutants has been in place since April 2005.

Data available from the EU in 2010 indicated that Ireland complied with the emissions ceilings for SO2, VOCs and NH3 but failed to comply with the ceiling for NO_X. 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 and $PM_{2.5}$.

In relation to Ireland, 2020-29 emission targets are for SO_2 (65% below 2005 levels), for NO_X (49% reduction), for VOCs (25% reduction), for NH_3 (1% reduction) and for $PM_{2.5}$ (18% reduction). In relation to 2030, Ireland's emission targets are for SO_2 (85% below 2005 levels), for NO_X (69% reduction), for VOCs (32% reduction), for NH_3 (5% reduction) and for $PM_{2.5}$ (41% reduction).

8.1.1.2 CLIMATE

Ireland ratified the United Nations Framework Convention on Climate Change in April 1994 and the Kyoto Protocol in principle in 1997 and formally in May 2002. For the purposes of the European Union burden sharing agreement under Article 4 of the Kyoto Protocol, in June 1998, Ireland agreed to limit the net growth of the six Greenhouse Gases under the Kyoto Protocol to 13% above the 1990 level over the period 2008 to 2012.

The UNFCCC is continuing detailed negotiations in relation to GHGs reductions and in relation to technical issues such as Emission Trading and burden sharing. The most recent Conference of the Parties to the Convention (COP23) took place in Bonn, Germany from the 6 to 17 of November 2017 and focused on advancing the implementation of the Paris Agreement.

The Paris Agreement was established at COP21 in Paris in 2015 and is an important milestone in terms of international climate change agreements. The "Paris Agreement", agreed by 200 nations, has a stated 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 greenhouse gas emissions will be based on Intended Nationally Determined Contributions (INDCs) which will form the foundation for climate action post 2020. Significant progress has also been made on elevating adaption onto the same level as action to cut and curb emissions.

The EU, on the 23/24 of October 2014, agreed the "2030 Climate and Energy Policy Framework". The European Council endorsed a binding EU target of at least a 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990. The target will be delivered collectively by the EU in the most cost-effective manner possible, with the reductions in the ETS and non-ETS sectors amounting to 43% and 30% by 2030 compared to 2005, respectively.

Secondly, it was agreed that all Member States will participate in this effort, balancing considerations of fairness and solidarity. The policy also outlines, under "Renewables and Energy Efficiency", an EU binding target of at least 27% for the share of renewable energy consumed in the EU in 2030

The Climate Action and Low Carbon Development Act 2015 sets out the national objective of transitioning to a low carbon, climate resilient and environmentally sustainable economy in the period up to 2050. The Act provides for the preparation of a yearly National Mitigation Plan which will specify policies to reduce greenhouse gas emissions for each sector, including transport.

8.1.1.3 DUST

There are no national or EU limits for dust deposition. However, the TA Luft Technical Instructions on Air Quality (TA Luft, 2002) provide a guideline for the rate of dust deposition of 350 mg/m^2/day averaged over one year.

8.2 METHODOLOGY

The assessment of air quality has been carried out using a phased approach as recommended by the UK DEFRA[1]. The phased approach recommends that the complexity of an air quality assessment be consistent with the risk of failing to achieve the air quality standards. In the current assessment, an initial scoping of possible key pollutants was carried out and the likely location of air pollution "hot-spots" identified.

An examination of recent EPA data[2] as well as the EPA website (http://www.epa.ie/air/quality2/data/) has indicated that SO_2, benzene, smoke and CO are unlikely to be exceeded at locations such as the current one and thus these pollutants do not require detailed monitoring or assessment to be carried out.

The initial scoping of pollutants did, however, indicate potential problems in regards to nitrogen dioxide (NO_2) and PM_{10} at busy junctions in urban centres.

The current assessment thus focused firstly on identifying the existing baseline levels of NO_2 and PM_{10} in the region of the proposed windfarm by an assessment of EPA monitoring data.

Thereafter, the impact of the development during the construction phase of the project on air quality at the neighbouring sensitive receptors was determined by an assessment of the dust generating construction activities associated with the proposed windfarm.

8.3 RECEIVING ENVIRONMENT

8.3.1 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).

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

[1] UK DEFRA (2009) Part IV of the Environment Act 1995: Local Air Quality Management, LAQM. TG(09)

[2] Environmental Protection Agency (2017) Air Quality Monitoring Report 2016

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 Finner, Ballyshannon, Co. Donegal, which is located approximately 35 km south of the site. Finner met data has been examined to identify the prevailing wind direction and average wind speeds over a five-year period.

The average wind speed over the period 1981 – 2010 is approximately 5.3 m/s. Although the wind rose gives an indication of the prevailing wind speed and direction in the general area, this data is not used in the air quality and climate assessment of the Graffy Wind Farm

8.3.2 Available Background Data

The Air Framework Directive deals with each EU member state in terms of "Zones" and "Agglomerations". These air quality zones have been declared for air quality management and assessment purposes. As part of the EU Framework Directive on Air Quality (1996/62/EC), four air quality zones have been defined for Ireland.

I. Zone A: Dublin Conurbation

II. Zone B: Cork Conurbation

III. Zone C: Other cities and large towns comprising Limerick, Galway, Waterford, Drogheda, Dundalk, Bray, Navan, Ennis, Tralee, Kilkenny, Carlow, Naas, Sligo, Newbridge, Mullingar, Wexford, Letterkenny, Athlone, Celbridge, Clonmel, Balbriggan, Greystones, Leixlip and Portlaoise

IV. Zone D: Rural Ireland, i.e. the remainder of the country excluding Zones A, B and C

Glenties is in Zone D. Zone D is comprised of rural Ireland outside the specified conurbations and large towns, with populations greater than 15,000.

These air quality zones have been declared for air quality management and assessment purposes. Having a population less than 15,000, the area in and around Glenties is classified as Zone D and therefore, is expected to have good air quality.

EPA mobile monitoring units monitor air quality at locations within Zone D. The typical baseline air quality data outlined below in Table 2 is based on a review of the EPA – Air Quality Monitoring Report 2007.

Table 2: Typical air quality monitoring data representative of EPA Zone D monitoring sites

Pollutant	Zone D Monitoring Stations	EPA Baseline Monitoring Data Annual Mean 2015	Relevant Limit Value
PM_{10}	Kilkitt Castlebar Enniscorthy Claremorris	9 µg/m³ 13 µg/m³ 18 µg/m³ 10 µg/m³	PM_{10} annual mean limit for the protection of human health = 40 µg/m³
$PM_{2.5}$	Longford Claremorris	18 µg/m³ 6 µg/m³	$PM_{2.5}$ annual mean limit for the protection of human health = 25 µg/m³
SO_2	Shannon Estuary Kilkitt Enniscorthy	2 µg/m³ 2 µg/m³ 2 µg/m³	SO_2 annual mean limit for the protection of vegetation= 20 µg/m³
NO_2	Kilkitt Castlebar Enniscorthy Emo Court	2 µg/m³ 8 µg/m³ 9 µg/m³ 3 µg/m³	NO_2 annual mean limit for the protection of human health = 40 µg/m³
NO_x	Kilkitt Castlebar Enniscorthy Emo Court	2 µg/m³ 11 µg/m³ 9 µg/m³ 3 µg/m³	NO_x annual mean limit for the protection of human health = 30 µg/m³
Lead	Kilkitt Castlebar	1.4 ng/m³ 1.9 ng/m³	Pb annual mean limit for the protection of human health = 0.5 µg/m³
Ozone	Valentia Kilkitt Castlebar Mace Head Emo Court	71 µg/m³ 60 µg/m³ 58 µg/m³ 76 µg/m³ 54 µg/m³	Maximum Ozone daily 8 – hour mean limit = No more than 25 days > 125 µg/m³
Carbon Monoxide	Enniscorthy	0.5 mg/m³	CO maximum daily 8 – hour mean value = 10 mg/m³

Pollutant	Zone D Monitoring Stations	EPA Baseline Monitoring Data Annual Mean 2015	Relevant Limit Value
Benzene (Note1)	Kilkenny Seville Lodge	0.13 $\mu g/m^3$	Benzene annual mean limit for the protection of human health = 5 $\mu g/m^3$

Note 1: No data was available for Zone D Benzene values , so Kilkenny Seville Lodge was used.

The proposed site is a rural location, with no obvious industrial sources within 2km.

In summary, existing baseline levels of NO_2, PM_{10} and $PM_{2.5}$ based on extensive long-term data from the EPA are well below ambient air quality limit values in the vicinity of the proposed windfarm

8.4 POTENTIAL IMPACTS OF DEVELOPMENT

From an air quality perspective, the construction phase for the proposal will be the key aspect in relation to the air quality assessment. The 8-turbine wind farm has been designed with an operational life of 25 years. At the end of this period, unless a further planning permission is sought, the turbines will be dismantled and removed from the site.

There is the potential for a number of emissions to the atmosphere during the construction of the development. In particular, the construction activities may generate quantities of dust. Construction vehicles, generators etc., will also give rise to some exhaust emissions. A dust minimisation plan will be formulated for the construction phase of the project, as construction activities are likely to generate some dust emissions.

From a climate perspective, the operational phase of the project is expected to lead to a beneficial impact on climate by displacing fossil-fuel derived electricity.

8.4.1 Construction Phase

Material handling activities, including excavation and backfill, on site may typically emit dust. Dust is characterised as encompassing particulate matter with a particle size of between 1 and 75 microns (1- 75 μm).

Deposition typically occurs in close proximity to each site and potential impacts generally occur within 500 metres of the dust generating activity as dust particles fall out of suspension in the air. Larger particles deposit closer to the generating source and deposition rates will decrease with distance from the source.

Sensitivity to dust depends on the duration of the dust deposition, the dust generating activity, and the nature of the deposit. Therefore, a higher tolerance of dust deposition is likely to be shown if only short periods of dust deposition are expected and the dust generating activity is either expected to stop or move on.

The potential for dust to be emitted will depend on the type of activity being carried out in conjunction with environmental factors including levels of rainfall, wind speed and wind direction. Activities associated with this development such as excavation and backfill have potential to generate dust.

The potential air quality and climate impacts that may arise during demolition and construction activities are:

- dust deposition, resulting in the soiling of surfaces;
- visible dust plumes, which are evidence of dust emissions;
- elevated PM_{10} concentrations, as a result of dust generating activities on site; and
- an increase in concentrations of airborne particles and nitrogen dioxide due to exhaust emissions from diesel powered vehicles and equipment used on site (non-road mobile machinery) and vehicles accessing the site.

As indicated, dust generation rates depend on the site activity, particle size (in particular the silt content, defined as particles smaller than 75 microns in size), the moisture content of the material and weather conditions. 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 Finner Meteorological Station identified that typically 246 days per annum are "wet". Thus, almost 70% of the time no significant dust generation will be likely due to meteorological conditions.

Large particle sizes (greater than 75 microns) fall rapidly out of atmospheric suspension and are subsequently deposited in close proximity to the source. Particle sizes of less than 75 microns are of interest as they can remain airborne for greater distances and can give rise to the potential dust nuisance at the sensitive receptors. This size range would broadly be described as silt.

Emission rates are normally predicted on a site-specific particle size distribution for each dust emission source. The nearest third-party receptor is at a distance of over 700m from the nearest turbine. Whilst construction activities are likely to produce some level of dust during earth moving and excavating phases of the project, these activities will mainly be confined to particles of dust greater than 10 microns. Particles of dust greater than 10 microns are considered a nuisance but do not have the potential to cause significant health impacts.

Bulldozing and compacting operations release 84% of particles which are greater than PM_{10} with only 16% of particles being less than 10 microns.

Due to the rural nature of the development, there are no receptors within 1 km of the application site boundary. As such, the potential for dust nuisance and significant levels of PM_{10} and $PM_{2.5}$ concentrations is predicted to be negligible.

8.4.1.1 TRAFFIC

Construction traffic and embodied energy are expected to be the dominant source of greenhouse gas emissions as a result of the development. Vehicles will give rise to greenhouse gas emissions during construction of the proposed windfarm and associated substation, external grid connection and haul road. There will be no processing of materials on site, this includes borrow pits or batching plants.

There will be an estimated 19,219 tonnes of stone for use in the construction of access roads, crane pads and other site activities. The quarry providing this stone will be, at worst, a distance of 20 km from the application site, the quarry will also provide an estimated 853 tonnes of sand.

Emissions with the potential to cause climate change will arise from embodied carbon dioxide in site materials, (6,070 m^3 of concrete, 304 tonnes of steel and 19,219 m^3 of imported crushed stone, 853 tonnes of sand) as well as roughly 20 kilometres travelled by vehicles delivering/removing this material to and from the construction site.

These emissions have been quantified using the UK Environment Agency carbon calculator for construction sites. It is predicted that up to 30 people could be on site at any time during peak construction. Emission estimates from the staff transportation, site works, concrete, crushed stone and removal of backfill and the associated road emissions of the HGV transporting them is 3,291 tonnes CO2eq.

These impacts are negative and is 0.0075% of Irelands 2016 total national greenhouse gas emissions.

This is a direct impact and classified as a temporary imperceptible impact.

8.4.1.2 TURBINE MANUFACTURE

The specifications of the 8 wind turbines to be used onsite have not been finalised. The expected electricity production is approximately 100,000 MWh per annum. The assessment will be undertaken using this value as it will provide the worst-case payback period scenario.

Information on the life cycle assessment undertaken for Enercon wind turbine, who are a major supplier of the wind turbines, has been reviewed. The life cycle assessment quantifies the associated power consumption associated with the production, operation, transport and end-of-life of the wind turbines.

The assessment also quantifies the associated greenhouse gas emissions associated with the production, operation, transport and end-of-life of the wind turbines. The energy balance associated with the wind power production during its lifetime (assumed to be 25 years) and the energy associated with the manufacturing, operation, transport, dismantling and disposal was also calculated on a site-specific basis as the energy balance is based on the expected GWh of production during its lifetime. The energy balance is expressed in terms of the time taken for the energy consumed by the turbine through its full life cycle to be repaid in terms of wind energy exported to the electricity grid.

Using the data contained in the life cycle assessments, a site-specific assessment of the energy balance for the current project has been undertaken:

- Annual expected MWh production = 100,000 MWh / Year
- Expected GWh production during lifetime (25 years) = 2,500 GWh
- Expected Energy Consumed / Turbine Life Cycle = 3,636 MWh
- Total Energy Consumed / 8 Turbines Life Cycle = 29,088 MWh
- Energy balance assessment period = 25 years
- Energy balance = (29,088 MWh /2,500,000 MWh)*300 months =3.5 months

8.4.2 Operational Phase

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 a negligible impact on air quality.

However, the generation of electricity due to the installation of the wind farm will lead to a net savings in terms of NO_x emissions. The windfarm will have an installed capacity of approximately 32.9 MW, therefore the power generation from the development is expected to be approximately 100 GWh per annum.

The generation of 100 GWh of electricity to the national grid will lead to a net savings in terms of NOx emissions which may have been emitted from fossil fuels to produce electricity. Results, outlined in Table 17.2, indicate that the impact of the wind farm on Ireland's obligations under the Gothenburg Protocol and the EU 20-20-20 Targets are positive. The annual impact of the development is to decrease annual NOx emission levels by 0.07% of the ceiling levels (relative to the NOx emissions associated with power generation in Ireland 2015).

In terms of the lifetime of the wind farm, the total NOX emission savings will amount to over 1,056 tonnes of NOx which is equivalent to 6.56% of the total NOx emissions from power generation in 2015 (Note: 2016 data not available in latest SEAI report).

Table 3: Impact of Graffy Wind Farm to Ireland Emissions Obligations

Scenario	NOx (tonnes)
Emissions saved due to Wind Farm	42.3
National Emissions Ceiling	65,000
Positive impact of wind farm (%age of annual emissions)	0.07%
Total NOx Saving over 25 years relative to NOx emissions from power generation in 2016	6.56%

8.4.2.1 CLIMATE

Vehicular traffic would be expected to be the dominant source of greenhouse gas emissions as a result of the development. Vehicles will give rise to CO_2 and NO_2 emissions near the proposed development. There will be no greenhouse gas emissions from the operation of the wind turbines.

However, due to the displacement of 100 GWh of electricity which otherwise would have been produced from fossil fuels, there will be a net benefit in terms of greenhouse gas emissions.

Greenhouse gases have different efficiencies in retaining solar energy in the atmosphere and

different lifetimes in the atmosphere. In order to compare different greenhouse gases, emissions are calculated on the basis of their Global Warming Potential (GWPs) over a 100-year period, giving a measure of their relative heating effect in the atmosphere. The GWP100 for CO2 is the basic unit (GWP = 1) whereas CH4 has a global warming potential equivalent to 21 units of CO2 and N2O has a GWP100 of 310.

Greenhouse gas emissions, as a result of this development, will be imperceptible in terms of Ireland's obligations under the European Union's Effort Sharing Decision (Decision 406/2009/EC). However, as stated above, the generation of 100 GWh of electricity to the national grid will lead to a net savings in terms of greenhouse gas emissions.

By 2020 Ireland is committed to meeting a target for gross electricity consumption in Ireland from renewable energy sources of 40%. It is envisaged that this target will be met mainly through wind power generation.

In 2016, SEAI states that wind energy accounted for over 22.3% of all electricity generation with a total installed generating capacity of 2,827 MW in 2016 in the Republic of Ireland. The average capacity factor varies on an annual basis with a capacity of 32% in 2015 which increased from 28% in 2014 and 2013. The peak recorded wind power output was 2,444 MW, delivered on 17 February 2017.

In general terms, CO_2 avoided through renewable energy use in all sectors totalled 3,932 kt CO_2 in 2016, with wind energy accounting for 2,188 kt CO2 of the savings. In order to calculate the net benefit in terms of greenhouse gas emissions, the greenhouse gas emissions from the average fossil fuel electricity mix in 2016 has been calculated.

The production of wind power for export to the national grid transforms the site from negative in terms of GHGs to having a net positive annual impact on GHG emissions of the order of 0.146% of the annual Total Greenhouse Gas Emissions in Ireland in 2016. In terms of the lifetime of the wind farm, the total GHG emission savings will amount to over 1,600,644 tonnes of CO_{2eq} which is equivalent to 12.7% of the total predicted annual GHG emissions from the energy sector in 2020.

8.4.3 Decommissioning Phase

The decommissioning phase will involve the removal of the turbines and associated site infrastructure e.g. met mast. In a similar way to the construction phase, this will have a short-term negative impact on the local air quality. However, due to the short term nature of any associated works and low background concentrations in the vicinity of the site it is predicted to have an imperceptible impact local air quality.

8.4.3.1 CLIMATE

Similar to the air quality impact, vehicles related to the decommissioning phase will give rise to CO2 and NO_2 emissions. It is not predicted that this development will involve the use of a significant number of vehicles during the decommissioning phase. Therefore, emissions from vehicular traffic, is predicted to be negligible as a result of the decommissioning.

In the decommissioning phase, the turbines are dismantled and the site is remediated to the agreed state. End-of-life recycling of metals will be carried out at the Windfarm in order to reduce the climate impact. Metal components that are primarily mono-material (e.g. gears, transformers, tower sections, etc.) are assumed to be 98% recycled.

It is expected that the reinforced concrete foundation bases will remain in-situ.

The climate impact due to decommissioning will be temporary and imperceptible if recycling of components is carried out where possible

8.5 DUST MINIMISATION

A dust minimisation plan will be formulated for the construction phase of the project, as construction activities in the construction and decommissioning phases are likely to generate some dust emissions. The potential for dust to be emitted depends on the type of construction activity being carried out in conjunction with environmental factors including levels of rainfall, wind speeds and wind direction. The potential for impact from dust depends on the distance to potentially sensitive locations and whether the wind can carry the dust to these locations.

The majority of any dust produced will be deposited close to the potential source and any impacts from dust deposition will typically be within several hundred metres of the construction area.

8.5.1 Dust Management Plan

The site operator will develop and implement a Dust Management Plan (DMP) to consider:

- Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
- Make the complaints log available to the local authority when asked.
- Record any exceptional incidents that cause dust and/or air emissions, either on or off site, and the action taken to resolve the situation in the logbook.
- Hard surface roads shall be swept to remove mud and aggregate materials from their surface
- Current forestry tracks to be upgraded
- Any road that has the potential to give rise to fugitive dust must be regularly watered, as appropriate, during dry and/or windy conditions.
- Avoid site runoff of water or mud.
- Cover, seed of fence stockpiles to prevent wind whipping, including delivery vehicles.
- Ensure all vehicles switch off engines when stationary – no idling vehicles.
- Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and 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 methods.

8.6 CONCLUSION

An assessment into the likely air quality and climate impact associated with the proposed Graffy Windfarm has been undertaken. The proposed application site will have up to 8 turbines with an export capacity to the grid of up to 32MW.

The wind farm anticipated life is 25 years after which the turbines will be decommissioned.

The assessment of baseline air quality in the region of the proposed windfarm has shown that current levels of key pollutants are significantly lower than their limit values.

Any impact of the Graffy windfarm development on Ireland's total national greenhouse gas emission is slight beneficial compared to Ireland's 2016 total greenhouse gas emissions and obligations under the EU 2020 commitments. Any adverse impacts are predicted to occur during the construction phase, with the dominant sources of greenhouse gas emissions as a result of the development due to the construction traffic and embodied energy of construction material.

The generation of 100 GWh of electricity to the national grid during the operational phase will lead to a net saving for the development in terms of greenhouse gas emissions. The production of wind power for export to the national grid transforms the proposed cumulative impacts from negative in terms of GHGs to having a net positive annual impact on GHG emissions of the order of 0.139% of the Total Greenhouse Gas Emissions in Ireland in 2016.

A dust minimisation plan is to be followed for the construction phase of the project, as construction activities are likely to generate some dust emissions, particularly during the construction of the grid connection. The majority of any dust produced will be deposited close to the potential source and any impacts from dust deposition will typically be within several hundred metres of the construction area. Due to the rural location of the Sheskin Windfarm, there are very few sensitive receptors within 1 km of the site boundary reducing the potential for impacts greatly. The potential for dust will be limited by the dust mitigation plan resulting in a temporary impact that is classed as negligible.

9. Cultural Heritage

Contents

9.1 ARCHAEOLOGICAL, ARCHITECTURAL AND CULTURAL HERITAGE

This chapter has been prepared by Dermot Nelis Archaeology to assess and define any impacts or effects which the construction, operation and decommissioning of the proposed development may have on the archaeological, architectural and cultural heritage resource. The chapter includes an identification of potential impacts or effects which may arise and outlines mitigation measures, based on current information, which may be used to avoid, reduce or offset any potential adverse effects.

9.2 OUTLINE OF THE SCOPE OF WORK

The objectives of this chapter are to:

- identify all known features of archaeological, architectural and cultural heritage importance in the vicinity of the proposed development;
- determine any potential impacts or effects of the proposed development on the archaeological, architectural and cultural heritage resource; and
- identify measures to mitigate any potential impacts or effects of the proposed development on the archaeological, architectural and cultural heritage resource.

The following key issues are addressed:

- Direct and indirect impacts or effects of the construction and the decommissioning of the proposed development on the archaeological, architectural and cultural heritage resource;
- Direct and indirect impacts or effects of the operation of the proposed development on the archaeological, architectural and cultural heritage resource; and
- Cumulative impacts or effects of the construction and operation of the proposed development on the archaeological, architectural and cultural heritage resource with other existing, permitted or proposed developments or projects.

9.2.1 The Proposed Development

The proposed development will involve the construction and operation of an eight no. turbine wind farm and associated infrastructure, one no. underground grid connection, one no. substation, a temporary construction compound, a turbine delivery route with associated road widening and a meteorological mast. (A detailed description of the proposed development is provided in **Chapter 2**).

9.2.2 Project Team

Dermot Nelis BA ArchOxon MIAI ACIfA

Dermot Nelis graduated from Queen's University Belfast, and after gaining extensive fieldwork experience undertook postgraduate studies at the University of Oxford in archaeological consultancy and project management.

Dermot has acted as Senior Archaeologist on several road schemes and directed large-scale multi-period excavations associated with those developments. He has completed over 170 Licensed fieldwork programmes and over 250 archaeological, architectural and cultural heritage desk-based reports and Environmental Impact Assessments.

9.3 METHODOLOGY

9.3.1 Study Area

There is no professional standard for defining the extent of a study area when assessing potential impacts or effects on archaeological, architectural or cultural heritage remains. A 5km study area has been imposed around the proposed wind farm, substation and meteorological mast to assess the presence of statutorily protected archaeological remains, World Heritage Sites, sites included in the Tentative List as consideration for nomination to the World Heritage List, National Monuments, sites with Preservation Orders or Temporary Orders, Protected Structures or structures recorded on the National Inventory of Architectural Heritage.

A 1km study area has been imposed around the proposed grid connection and turbine delivery route to assess the presence of statutorily protected archaeological remains, World Heritage Sites, sites included in the Tentative List as consideration for nomination to the World Heritage List, National Monuments, sites with Preservation Orders or Temporary Orders, Protected Structures, or structures recorded on the National Inventory of Architectural Heritage.

A 1km study area has been imposed around the proposed wind farm, substation, meteorological mast, grid connection and turbine delivery route to assess the presence of historic gardens or designed landscapes recorded on the National Inventory of Architectural Heritage.

9.3.2 Sources of Information

Research has been undertaken in two phases. The first phase comprised a desk review, namely a paper and digital survey of archaeological, historical and cartographic sources. The second phase involved field inspections of the proposed development area. Each phase is outlined in the following sections.

The following sources were examined and a list of sites and areas of archaeological, architectural and cultural heritage potential was compiled:

- Record of Monuments and Places of County Donegal;
- Topographical Files of the National Museum of Ireland;
- Cartographic and documentary sources relating to the study area;
- Aerial photographs of Ordnance Survey Ireland and Bing aerial photography;
- County Donegal Development Plan (2018 - 2024);
- National Inventory of Archaeological Heritage; and
- Environmental Protection Agency's *Guidelines on the Information to be Contained in Environmental Impact Statements* (2002) and *Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports* (2017).

Record of Monuments and Places (RMP) is a list of archaeological sites known to the National Monuments Service. Back-up files of the Sites and Monuments Record (SMR) provide details of documentary sources and field inspections where these have taken place.
Topographical Files of the National Museum of Ireland is the archive of all known finds recorded by the National Museum. This archive relates primarily to artefacts, but also includes references to monuments and unique records of previous excavations. The find spots of artefacts are important sources of information in the discovery of sites of archaeological significance.

Cartographic sources are important in tracing land-use development within an area of land take, as well as providing important topographical information on sites and areas of archaeological potential. Cartographic analysis of relevant maps has been made to identify any topographical anomalies that may no longer remain within the landscape.

Documentary sources were consulted to gain background information on the historical and archaeological landscape of the wider development area.

Aerial photographic coverage is an important source of information regarding the precise location of sites and their extent. It also provides initial information on the terrain and its potential to contain previously unidentified archaeological remains.

County Donegal Development Plan (2018 - 2024) contains Objectives and Policies on the preservation and management of archaeological, architectural and cultural heritage features.

National Inventory of Architectural Heritage (NIAH) is a section within the Department of Culture, Heritage and the Gaeltacht. The work of NIAH involves identifying, recording and evaluating on a non-statutory basis the architectural heritage of Ireland from 1700 to the present day. The NIAH website also contains a non-statutory register of historic gardens and designed landscapes in County Donegal.

Environment Protection Agency's *Guidelines on the Information to be Contained in Environmental Impact Statements* (2002) and *Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports* (2017) provide definitions for potential impacts and effects on archaeological, architectural and cultural heritage remains.

9.3.3 Field Inspection

Field inspection is necessary to determine the extent, character and condition of archaeological, architectural and cultural heritage features, and can also lead to the identification of previously unrecorded or suspected sites and portable finds through topographical observation and local information.

Site visits took place on 24th April 2019, 26th February 2020 and 2nd December 2020. Areas of proposed land take associated with the eight no. turbine wind farm, substation and meteorological mast were walked and visually assessed. The proposed grid connection along the line of a public road was assessed by means of a detailed windshield survey, while the grid connection on private land at the western end of the scheme was walked and visually assessed.

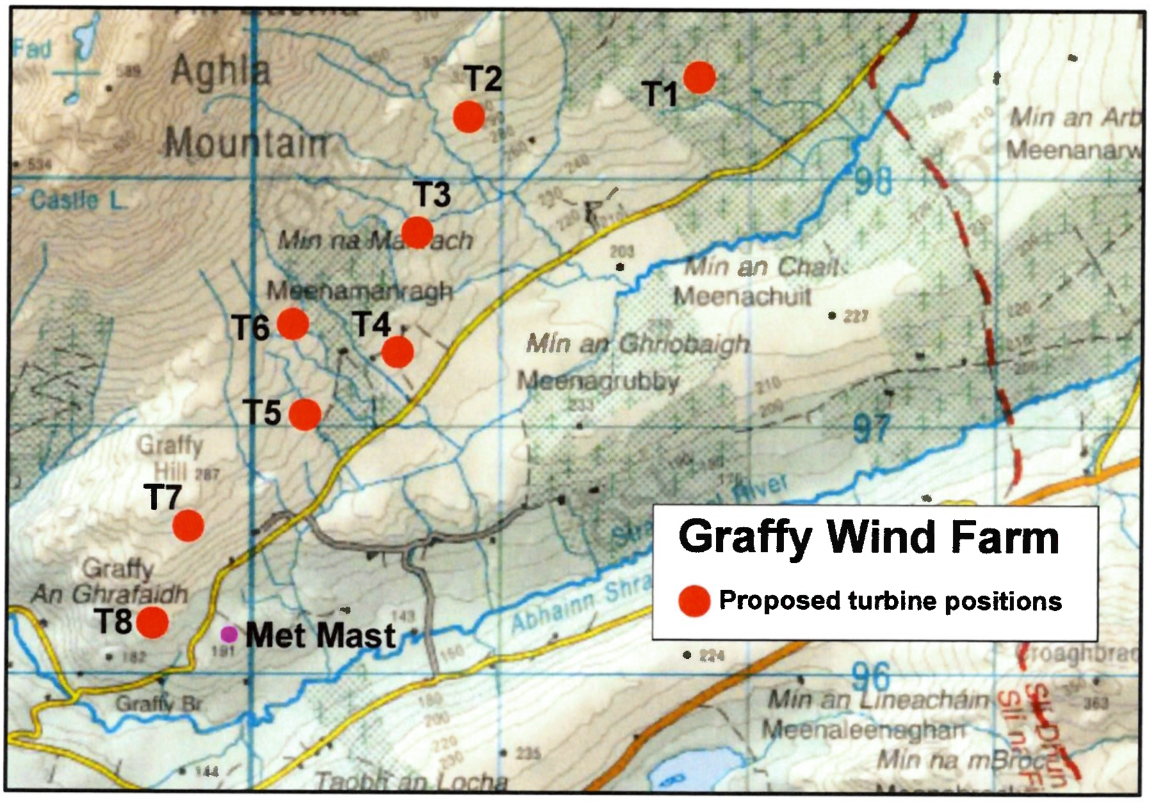

Figure 9.1: Location of Turbines

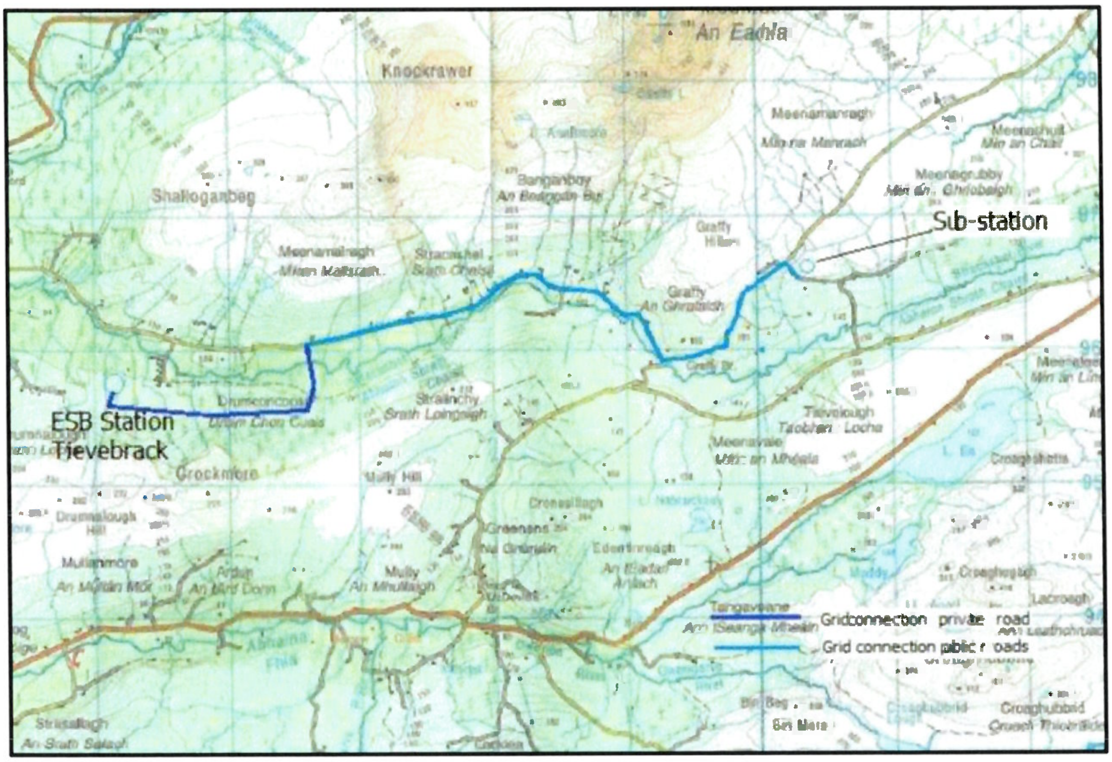

Figure 9.2: Location of the grid connection

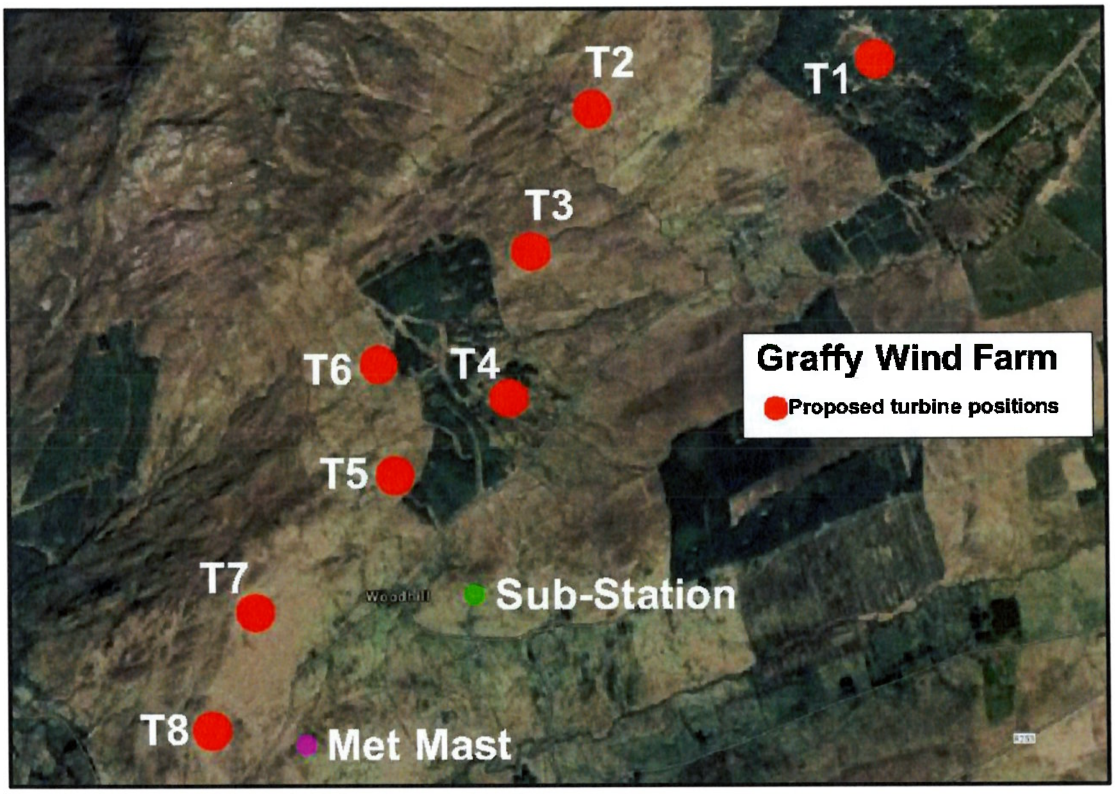

Figure 9.3: Aerial photograph showing location of Turbines 1 – 8, substation and meteorological mast

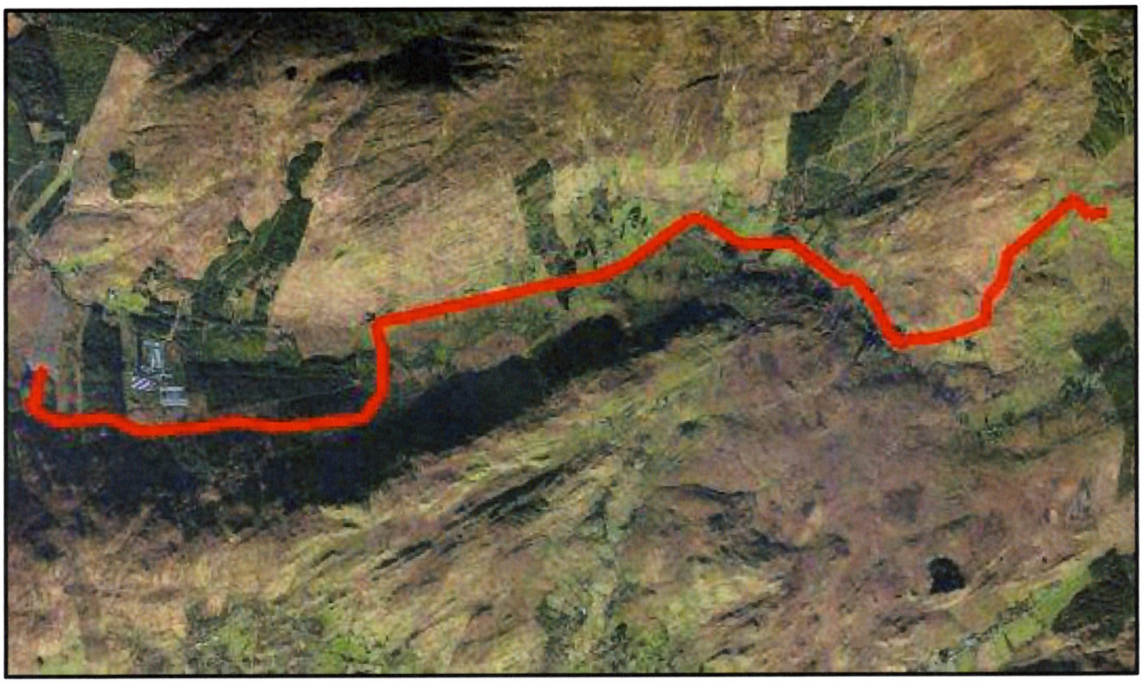

Figure 9.4: Aerial photograph showing line of the grid connection

9.3.4 Policy and Legislation

9.3.4.1 Archaeological Heritage

The National Monuments Act, 1930 to 2004 and relevant provisions of the National Cultural Institutions Act, 1997 are the primary means of ensuring the satisfactory protection of archaeological remains, which includes all man-made structures of whatever form or date except buildings habitually used for ecclesiastical purposes.

A number of mechanisms under the National Monuments Act are applied to secure the protection of archaeological monuments. These include the Record of Monuments and Places, the Register of Historic Monuments, the placing of Preservation Orders and Temporary Preservation Orders on endangered sites and National Monuments in the Ownership or Guardianship of the Minister for Culture, Heritage and the Gaeltacht or a Local Authority.

The Minister may acquire National Monuments by agreement or by compulsory order. The State or the Local Authority may assume Guardianship of any National Monument (other than dwellings). The owners of National Monuments (other than dwellings) may also appoint the Minister or the Local Authority as Guardian of that monument if the State or Local Authority agrees. Once the site is in ownership or Guardianship of the State, it may not be interfered with without the written consent of the Minister.

Section 5 of the 1987 Act requires the Minister to establish and maintain a Register of Historic Monuments. Historic Monuments and archaeological areas present on the Register are afforded statutory protection under the 1987 Act. Any interference with sites recorded on the Register is illegal without the permission of the Minister. Two months' notice in writing is required prior to any work being undertaken on or in the vicinity of a Registered Monument. The Register also includes sites under Preservation Orders and Temporary Preservation Orders. All Registered Monuments are included in the Record of Monuments and Places.

Sites deemed to be in danger of injury or destruction can be allocated Preservation Orders under the 1930 Act. Preservation Orders make any interference with the site illegal. Temporary Preservation Orders can be attached under the 1954 Act. These perform the same function as a Preservation Order but have a time limit of six months, after which the situation must be reviewed. Work may only be undertaken on or in the vicinity of sites under Preservation Orders with the written consent, and at the discretion, of the Minister.

Section 12(1) of the 1994 Act requires the Minister to establish and maintain a Record of Monuments and Places where the Minister believes that such monuments exist. The Record comprises a list of monuments and relevant places and a map/s showing each monument and relevant place in respect of each county in the State. All sites recorded on the Record of Monuments and Places receive statutory protection under the National Monuments Act 1994.

Section 12(3) of the 1994 Act provides that:

> *"where the owner or occupier (other than the Minister for Arts, Heritage and the Gaeltacht) of a monument or place included in the Record, or any other person, proposes to carry out, or to cause or permit the carrying out of, any work at or in*

relation to such a monument or place, he or she shall give notice in writing to the Minister of Arts, Heritage and the Gaeltacht to carry out work and shall not, except in the case of urgent necessity and with the consent of the Minister, commence the work until two months after the giving of notice" (www.archaeology.ie).

9.3.4.2 Architectural and Built Heritage

The main laws protecting the built heritage are the Architectural Heritage (National Inventory) and Historic Properties (Miscellaneous Provisions) Act, 1999 and the Planning and Development Act, 2000 (Amended 2010). The Architectural Heritage Act requires the Minister to establish a survey to identify, record and assess the architectural heritage of the country. The National Inventory of Architectural Heritage records built heritage structures within all the counties of the State. As inclusion in the Inventory does not provide statutory protection, the document is used to advise Local Authorities on compilation of a Record of Protected Structures (RPS) as required by the Planning and Development Act, 2000.

The Planning and Development Act, 2000 requires Local Authorities to establish a Record of Protected Structures to be included in the County Development Plan. This Plan includes objectives and policies designed to protect the archaeological, architectural and cultural heritage resource during the planning process. Buildings recorded in the RPS can include Recorded Monuments, structures listed in the NIAH, or buildings deemed to be of architectural, archaeological or artistic importance by the Minister. Sites, areas or structures of archaeological, architectural or artistic interest listed in the RPS receive statutory protection from injury or demolition under the 2000 Act. Damage to or demolition of a site registered on the RPS is an offence. The RPS is not always comprehensive in every county.

A Local Authority has the power to order conservation and restoration works to be undertaken by the owner of a Protected Structure if it considers the building in need of repair. An owner or developer must make a written request to a Local Authority to carry out any works on a Protected Structure and its environs, which will be reviewed within 12 weeks of application. Failure to do so may result in prosecution.

9.3 5 Significance of Crite ria

9.3.5.1 Potential Impacts on Archaeological, Architectural and Cultural Heritage Remains

The likelihood of impacts or effects can be identified from detailed information about a project, the nature of the area affected and the range of resources potentially affected. The construction and operation of wind farms and their associated activities can affect the archaeological, architectural and cultural heritage resource of a given landscape in a number of ways:

- Permanent and temporary land-take, associated structures, landscape mounding, and their construction may result in damage to or loss of archaeological remains and deposits, or physical loss to the setting of historic monuments and to the physical coherence of the landscape;

- Archaeological sites can be affected adversely in a number of ways: disturbance by excavation, topsoil stripping and the passage of heavy machinery, disturbance by vehicles working in unsuitable conditions, and burial of sites thus limiting accessibility for future archaeological investigation;

- Hydrological changes in groundwater or surface water levels can result from construction activities such as de-watering and spoil disposal, or long-term changes in drainage patterns. These may desiccate archaeological remains and associated deposits;

- Visual and noise impacts on the historic landscape can arise from construction traffic and facilities, built earthworks and structures, landscape mounding and planting, noise, fences and associated works. These features can impinge directly on historic structures and historic landscape elements as well as their visual amenity value;

- Landscape measures, such as tree planting, can damage sub-surface archaeological features due to topsoil stripping and through the root action of trees and shrubs as they grow;

- Ground consolidation by construction activities or the weight of permanent embankments can cause damage to buried archaeological remains, especially in colluvium or peat deposits;

- Disruption due to construction also offers in general the potential for adversely affecting archaeological remains. This can include machinery, site offices, service trenches, *etc.*; and

- Although not widely appreciated, positive impacts or effects can accrue from permitted developments. These can include positive resource management policies, improved maintenance and access to archaeological monuments, and the increased level of knowledge of a site or historic landscape as a result of assessment and fieldwork.

9.3.5.2 Predicted Impacts on Archaeological, Architectural and Cultural Heritage Remains

There is no standard scale against which the significance of impacts or effects on the archaeological and historic landscape may be judged. The severity of a given level of land take or visual intrusion varies with the type of monument, site or landscape features and its environment. Significance of impact can be judged taking the following into account:

- The proportion of the feature affected and how far physical characteristics fundamental to the understanding of the feature would be lost;
- Consideration of the type, date, survival/condition, fragility/vulnerability, rarity, potential and amenity value of the feature affected; and
- Assessment of the levels of visual, noise and hydrological impacts, either in general or site specific terms, as may be provided by other specialists.

For this assessment the significant effects criteria outlined in **Table 9.1** are used:

Table 9.1: Significance of Effects

Level of Impact	Significance Criteria
Imperceptible	An effect capable of measurement but without significant consequences
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences
Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate Effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends

Significant Effects	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment
Profound Effects	An effect which obliterates sensitive characteristics

9.4 BASELINE CONDITIONS

9.4.1 Archaeological and Historical Background

Donegal is located on the north western seaboard and comprises a land mass of 486,091 hectares (6.9% of the total land area of the State) (Donegal County Council 2006, 6). The county is dominated by a mountainous granite spine running north east to south west comprising the mountain ranges of Derryveagh. To the south west of these ranges is a massive peninsula of hard quartzite mountains, known as the Blue Stack Mountains, extending from Ballybofey to Glencolumbkille on the west coast. To the east of the Derryveagh mountain range, drift soil provides some of the best agricultural land in the county, such as in the Finn Valley. Of the 1.2 million acres of land that make up County Donegal, almost 800,000 acres is rough pasture and upland bog (*ibid.*, 91).

Donegal contains the second largest Gaeltacht in the country, stretching from parts of the north coast (Fanad Head) as far as Glencolumbkille on the south west coast. The Gaeltacht, with its unique cultural traditional and linguistic heritage, occupies almost a third of the county (*ibid.*, 6).

During the Mesolithic period (*c.* 7000-4000 BC) people existed as hunters/gatherers, living on the coastline, along rivers and lakesides. They used flint and other stones to manufacture sharp tools, and locating scatters of discarded stone tools and debris from their manufacture can sometimes identify settlements. The earliest evidence of settlement in County Donegal dates to this period and is represented by early Mesolithic material (*c.* 7000 – 5500 BC) recovered from a beach at Greencastle in north Inishowen. A collection of narrow blades, also thought to possibly date to the early Mesolithic, were found under peat bog near Castlefin close to the River Finn (Lacy 2002, 3). Lacy argues that the finds of Mesolithic artefacts recovered in Donegal around the two substantial rivers of the area, the Foyle and the Finn, are consistent with the riverine and estuarine conditions favoured by Mesolithic settlers. He argues these rivers served as a water highway into the interior of the country during the Mesolithic period and were probably travelled by the earliest food-gathering settlers in Ireland (Lacy 1983, 5). This point is further supported by a find of several Bann Flakes (a late Mesolithic tool) on the western shoreline of the Foyle, just north of Derry. This relative concentration of Mesolithic activity forms a contrast to many other parts of the county, which through a combination of poor and isolated land appear to have not been widely settled during this period. Later Mesolithic material (*c.* 5500 – 4000 BC) has also been found in the form of a flintworking site on a raised beach at Dunaff Bay in Inishowen (Lacy 2002, 260). Further Bann flakes have also been recovered from five locations, one at Horn Head and the others in the general Raphoe area, in the east of the county.

During the Neolithic period (*c.* 4000-2400 BC) the population became more settled with a subsistence economy based on crop growing and stock-raising. This period also saw changes in burial practices and a tradition of burying the dead collectively and carrying out of cremations emerged. Unlike the relative scarcity of Mesolithic evidence in County Donegal, the Neolithic is better represented. Of the approximate 1,400 megalithic tombs recorded in the country, 138 have been identified in Donegal, suggesting the area was relatively important throughout the Neolithic and early Bronze Age, after which time this form of burial practice ended (Lacy 1983, 14). These tombs have been recognised as falling into four distinct groups, identified on the basis of their architecture, distribution, date range and associated architecture: court tombs, portal tombs, passage tombs and wedge tombs (De Valera and Ó Nualláin 1961, xii-xiv).

An unclassified megalithic tomb (RMP DG066:002, figure 9.5) is located approximately 2.7km north of Turbine 1 in An Cró Cam townland. It is recorded (www.archaeology) as being deeply embedded in bog, consisting of a narrow gallery 5m long and orientated south south west/north north east. The present floor of the gallery is somewhat below the level of the surrounding ground. The remains are those of a megalithic tomb, but it cannot reliably be classified in its present state. The stone at right angles to the western end of the gallery however could be interpreted as a facade-stone, which would suggest that it may be a wedge tomb. (Wedge tombs have a long burial gallery, sometimes with an antechamber or small closed end-chamber. They are generally broader and higher at the front, which invariably faces in a westerly direction. They are roofed by slabs laid directly on the side-walls which often have one or more rows of outer- walling. Evidence from the small number of excavated examples suggests they were built between 2500 and 2000 BC, representing the last phase of megalithic tomb building in Ireland).

A megalithic structure (RMP DG066:004, figure 9.5) is recorded approximately 3.2km north of Turbine 1 in An Curraoin townland. It is recorded on the Third Edition 1:10,560 Ordnance Survey map (1906 - 1907) as "*Finnygals Apron Stones*" (www.archaeology.ie). There is no further information provided on this possible site on National Monuments Service's online database.

The Bronze Age (*c*. 2400-600 BC) is characterised by the introduction of metalworking technology to Ireland and coincides with many changes in the archaeological record, both in terms of material culture as well as the nature of the sites and monuments themselves. Though this activity has markedly different characteristics to that of the preceding Neolithic period, including new structural forms and new artefacts, it also reflects a degree of continuity. In addition to changes in material culture, there were changes in burial rite from communal megalithic tombs to single burial in cists

Bronze Age monuments from County Donegal include standing stones, stone circles and alignments, cist and pit burials, cairns, barrows, rock art and *fulachta fiadh,* which are one of the most numerous monument types in Ireland with over 4,500 examples recorded (Waddell 2005, 174).

A ring-barrow (RMP DG075:003, figure 9.5) is recorded approximately 3.4km south west of Turbine 8 in the townland of Corr na nGriollach. It is the site of a low mound (up to 0.37m high) enclosed by a ditch *c*. 0.4m wide. There are traces of a low external bank *c*. 0.1m high and up to 4.2m wide on the southern half. It has an internal diameter of 12m east/west x 10.9m north/south.

Ring-barrows are circular mounds of earth surrounded by a ditch with an external bank. The mounds were usually quite low and often were no higher than the surrounding bank (*ibid*., 365). They are widely distributed, and while they vary in size most seem to range in overall diameter from approximately 15m to 25m. The limited evidence of circular ring-barrows and ring-ditches indicates cremation-type burials from the later centuries BC and early centuries AD, with the occasional deposition of small token deposits of bone (*ibid.*, 368).

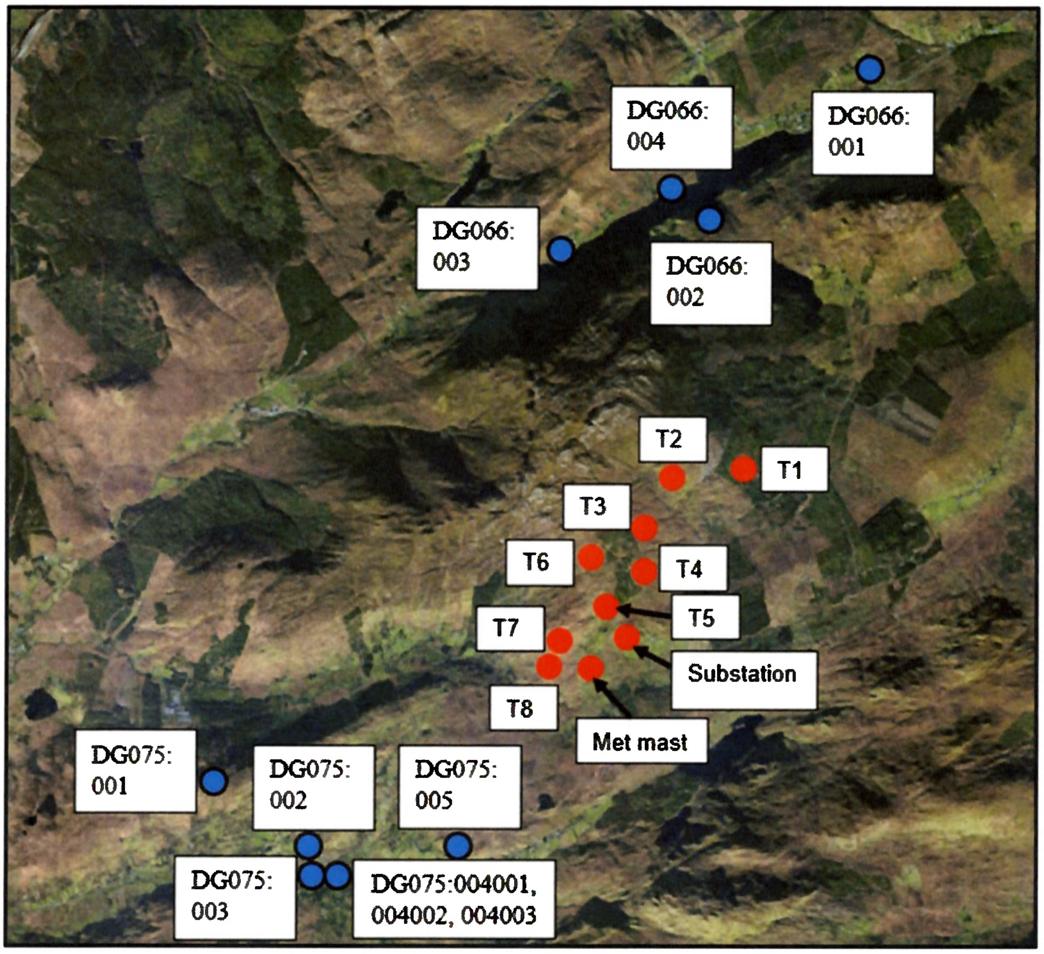

Figure 9.5: Recorded Monuments within 5km of the wind farm, substation and meteorological mast

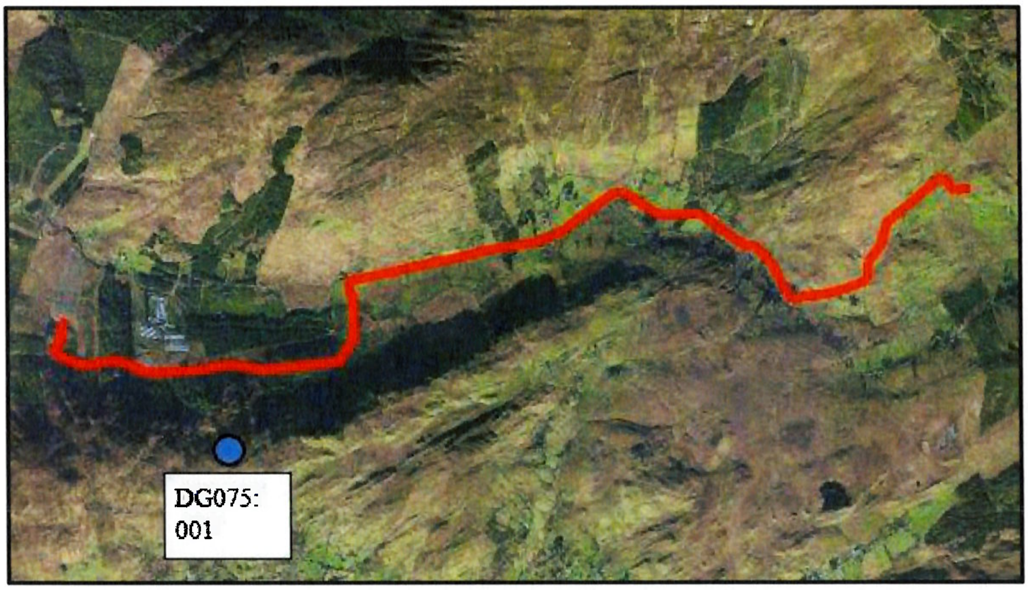

Figure 9.6: Recorded Monument within 1km of the grid connection

A structure (RMP DG075:002, figure 9.5) is recorded approximately 3.3km south west of Turbine 8 in An Mhullaigh townland. It is recorded in the SMR file as an upright slab measuring 2m long x 0.4m thick x 1.6m high, which supports the eastern end of a 2.3m long x 1.6m wide roofing slab. There is another slab on the ground nearby to the south. It is noted (www.archaeology.ie) that it is a shelter-like feature built against the steep face of a rocky knoll.

During the Iron Age (*c*. 600 BC-400 AD) new influences came into Ireland which gradually introduced the knowledge and use of iron, although for several centuries bronze continued to be widely used. The Iron Age in Ireland however is problematic for archaeologists as few artefacts dating exclusively to this period have been found, and without extensive excavation it cannot be determined whether several monument types, such as ring-barrows or standing stones, date to the Bronze Age or Iron Age.

A small number of exceptional artefacts dating to the Iron Age have been found in Donegal, and these include the Ballyshannon sword hilt and a collection of carved stone heads from Raphoe. While there have been very few settlement sites definitively recognised as dating to this period, hillforts on the summits of Grianán Mountain, McGonigle's Fort at Glasbolie, and Croaghan Hill near Lifford almost certainly date to the early Bronze Age or Iron Age. The surviving cairn at Croaghan Hill indicates that this site was also in use in prehistoric times

(Lacy 1983, 6). A number of the coastal promontory forts found in the county may also date to this period (Lacy 2002, 19).

The Early Medieval period (*c.* 400-1169 AD) is depicted in the surviving sources as entirely rural, characterised by the basic territorial unit known as *túath.* Walsh (2000, 30) estimates that there were at least 100, and perhaps as many as 150, kings in Ireland at any given time during this period, each ruling over his own *túath.*

During the 5th century AD the three branches of the Northern Uí Néill dynasty conquered the area of Donegal and gained complete political domination over the whole county. By the following century two branches of this dynasty came to dominate the area, with Cinéal Eoghain comprising the territory of Inishowen, and Cinéal Conaill, the territory of west and south Donegal. It is argued the Cinéal Eoghain were the most powerful political dynasty in Ireland during the Early Medieval period (Mac Giolla Easpaig 2002, 150).

During this turbulent period roughly circular defensive enclosures known as ringforts were constructed to protect farmsteads. They were enclosed by an earthen bank and exterior ditch, and ranged from approximately 25m to 50m in diameter. The smaller sized and single banked type (univallate) was more than likely home to the lower ranks of society, while larger examples with more than one bank (bivallate/trivallate) housed the more powerful kings and lords. They are regarded as defended family homesteads, and the extant dating evidence suggests they were primarily built between the 7th and 9th centuries AD (Stout 1997, 22-31).

The ringfort is considered to be the most common indicator of settlement during the Early Medieval period. The most recent detailed study (*ibid.*, 53) has suggested that there is an approximate total of 45,119 potential ringforts or enclosure sites throughout Ireland.

A ringfort (RMP DG075:001, figures 9.5 and 9.6) is recorded approximately 3.9m south west of Turbine 8 and approximately 0.6km south of the grid connection on the boundary between An tArd Donn and Droim Chon Cuais townlands. The SMR file notes that local tradition suggests the presence of a "*fort*" at this location, but there is no above-ground evidence of a structure to support this suggestion. The location is the summit of Crockmore Hill on marshy heather-covered ground.

A ringfort (RMP DG075:005, figure 9.5) is recorded approximately 2.4m south west of Turbine 8 in An tSeanga Mheáin townland. It is recorded in the SMR file as an almost circular area enclosed by an earthen bank and with an internal diameter of 25.5m. There is a low ledge on the outside of the bank and outside of this are traces of a silted-up fosse. There is evidence of an internal stone revetment in the eastern quadrant. The bank survives to a height of over 2m on the north side. A 3m wide gap in the south east quadrant is interpreted as being the original entrance.

Enclosures belong to a classification of monument whose precise nature is unclear. Often they may represent ringforts, which have either been damaged to a point where they cannot be positively recognised, or are smaller or more irregular in plan than the accepted range for a ringfort. An Early Medieval date is generally likely for this site type, though not a certainty.

The Early Medieval period is characterised by the foundation of a large number of ecclesiastical sites throughout Ireland in the centuries following the introduction of Christianity in the 5^{th} century AD. The early churches tended to be constructed of wood or post-and-wattle, although between the late 8^{th} and 10^{th} centuries mortared stone churches gradually replaced the earlier structures. Many of the sites, some of which were monastic foundations, were probably originally defined by an enclosing wall or bank similar to that found at coeval secular sites. This enclosing feature was possibly built more to define the sacred character of the area of the church than as a defence against aggression. An inner and outer enclosure can be seen at some of the more important sites; the inner enclosure surrounding the sacred area of church and burial ground and the outer enclosure providing a boundary around living quarters and craft areas. Where remains of an enclosure survive it is often the only evidence that the site was an early Christian foundation.

A "*Killeen Burial Ground*" (RMP DG075:004001, figure 9.5) is recorded approximately 3.3km south west of Turbine 8 in Lag na Gaileadh townland. It consists of an oval mound (RMP DG075:004003) of earth and stone measuring 1.28m high x 18.4m north/south x 13.7m east/west. A cross-slab (RMP DG075:004002) is located 2.5m north of the top centre of the mound. This measures 0.69m wide x 0.42m high x 0.09m to 0.12m thick. On it is a simple incised cross 0.2m long x 0.14m wide. This site is located in good pastureland on the south bank of the Owenea River and east of one of its small tributaries.

A burial ground (RMP DG066:001, figure 9.5) is recorded approximately 4.6km north east of Turbine 1 in Baile na Finne townland. The area is known locally as a graveyard, but no burial markers are recorded. The site is located in a marshy, hummocky field covered with heather.

A mound (RMP DG066:003, figure 9.5) is recorded approximately 2.9km north west of Turbine 2 in An Curraoin townland. It is noted (www.archaeology.ie) there is no above-ground evidence for this feature, which is recorded on the Third Edition 1:10,560 Ordnance Survey map (1906 - 1907) as "*Finngals Grave*".

The commencement of Viking raids at the end of the 8th century and their subsequent settlement during the following two centuries marked the first ever foreign invasion of Ireland. Viking settlement evidence is scarce and has been found in Cork, Dublin and Waterford, however excavations there have revealed extensive remains of the Viking towns. Outside these towns, understanding of Viking settlement is largely drawn from documentary and place-name evidence. In addition to Cork, Dublin and Waterford, documentary sources provide evidence for the Viking foundation of the coastal towns of Limerick and Wexford (Edwards 2006, 179). Other indirect evidence which suggest Viking settlement, or at least a Norse influence in Ireland, is represented by upwards of 120 Viking-age coin hoards, possible votive offerings of Viking style objects and the assimilation of Scandinavian art styles into Irish designs. While the initial Viking raids would have been traumatic, the wealth and urban expansion brought into the country as a result of Viking trading would have benefited the Gaelic Irish, and cultural assimilation in some parts would have been significant.

A number of artefacts that are probably of Viking origin have been found in Donegal. These include a collection of arm-rings from north west Inishowen, a probable Viking hoard of Anglo-Saxon coins found on the eastern shore of Lough Swilly in the 19th century, and a collection of silver ingots and jewellery found in the vicinity of Raphoe. Additionally, there are also several literary references to a Viking presence in Donegal (Lacy 1983, 7)

The arrival of Anglo-Normans in Ireland towards the end of the 12th century resulted in great changes during the following century. Large numbers of colonists arrived from England and Wales and established towns and villages. They brought with them new methods of agriculture which facilitated an intensification of production. Surplus foods were exported to markets all along Atlantic Europe which created great wealth and economic growth. Results of this wealth can be seen in the landscape in the form of stone castles, churches and monasteries. The presence of the Anglo-Normans in Donegal is well documented through the *Annals of Ulster*, which record that in 1199 John de Courcy plundered Inishowen after camping in Derry for nine days (*ibid.*, 8).

The political structure of Anglo-Normans centered around the establishment of shires, manors, castles, villages and churches. In the initial decades after the Anglo-Norman invasion a distinctive type of earth and timber fortification was constructed- the motte and bailey. Mottes were raised mounds of earth topped with a wooden or stone tower, while the bailey was an enclosure surrounded by an earthen ditch with a timber palisade used to house ancillary structures, horses and livestock.

The most important archaeological evidence for Anglo-Norman presence in Donegal is the "*great pile of Greencastle*" built in 1305 by Richard de Burgo Earl of Ulster at the entrance to Lough Foyle (*ibid.*, 9). It was known at that time as Northburgh or Newcastle, and its construction is recorded in the *Annals of the Four Masters*.

In certain areas of Ireland however Anglo-Norman settlers constructed square or rectangular enclosures, now termed moated sites. Their main defensive feature was a wide, often water-filled, fosse with an internal bank. As in the case of ringforts, these enclosures protected a house and outbuildings usually built of wood. They appear to have been constructed in the latter part of the 13th century though little precise information is available.

More substantial stone castles followed the motte and bailey and moated sites in the 13th and 14th centuries. Tower houses are regarded as a late type of castle and were erected from the 14th to early 17th centuries. Their primary function was defensive, with narrow windows and a tower often surrounded by a high stone wall (bawn). An Act of Parliament of 1429 gave a subsidy of £10 to "*liege*" men to build castles of a minimum size of 20ft in length, 16ft in breadth and 40ft in height (6m x 5m x 12m). By 1449 so many of these £10 castles had been built that a limit had to be placed on the number of grants being made available. The later tower houses were often smaller, with less bulky walls and no vaulting.

The 14^{th} century throughout north west Europe is generally regarded as having been a time of crisis, and Ireland was no exception. Although the Irish economy had been growing in the late 13^{th} century, it was not growing quickly enough to support the rapidly expanding population, especially when Edward I was using the trade of Irish goods to finance his campaigns in Scotland and Wales. When the Great European Famine of 1315-1317 arrived in Ireland, brought about by lengthy periods of severe weather and climate change, its effects were exacerbated by the Bruce Invasion of 1315-1318. Manorial records which date to the early 14^{th} century show that there was a noticeable decline in agricultural production. This economic instability and decline was further worsened with the onset of the Bubonic Plague in 1348.

Before the Tudors came to the throne the kings of England were also the kings of western France and so, during the 14^{th} and 15^{th} centuries, the various lords who ruled in Ireland were largely left to themselves. After the withdrawal of the Normans from the Inishowen peninsula in 1333, Donegal passed in entirety to the Cinéal Conaill under the O'Donnells, however the O'Neills, who now fully ruled Tyrone, continued to lay claim to the territory. By the time of the establishment of the present county border, and in the face of Elizabethan conquest, the longstanding rivalry of the two ancient factions had been resolved (*ibid.*, 9).

The Tudor conquest brought a much greater interest in the affairs of Ireland. They wanted to put a stop to the raids of the Gaelic Irish on areas under English rule, and to do this they ruthlessly put down any rebellions and even quashed inter-tribal feuds. English settlers were then brought in to settle their lands. The first of these plantations occurred in the mid-16^{th} century in what is now Laois and Offaly. After the Desmond rising in Munster in 1585 came another plantation, and parts of south western Tipperary were planted at that time. By 1600 permanent garrisons were established by the Tudor government within Donegal. Sir Henry Dowcra established the Governorship of Lough Foyle, which included the northern part of the county, and from his base at Derry further garrisons were planted in northern and eastern Donegal, at Rathmullan and Lifford.

From 1593 until 1603 there was a countrywide war between the Gaelic Irish, who were supported by the French, and the Elizabethan English. The Irish were finally defeated and with the "*Flight of the Earls*" from Rathmullan, County Donegal in 1607, Ulster, which had previously been independent of English rule, was planted. Subsequently Donegal was divided into numerous plantation estates, and several planned towns, many of which preserve their original layout to the present day, were built at that time.

Expansion in the agricultural sector following a period of economic growth in Ireland from the mid-1730s led to rising prices and increase in trade. This increase in agricultural productivity lead to growth in related industrial development throughout the country.

The proposed wind farm, grid connection, substation, meteorological mast, turbine delivery route and road widening junction will be located within the following townlands: *An Beangán Búi* (Banganboy), *An Dearachán Mór* (Dalraghan More), *An Ghrafaidh* (Graffy), *An Liuchmhín* (Lughveen), *Droim an Locha* (Drumnalough), *Droim Chon Cuais* (Drumconcoose), *Mín an Ghriobaigh* (Meenagrubby), *Mín na Mallsrath* (Meenamalragh), *Mín na Manrach* (Meenamanragh), *Srath Chaisil* (Stracashel) and *Taobh Riach* (Tievereagh). All townlands are in the barony of Boylagh and parish of Inishkeel.

Lewis (1837, 22) records the parish of Inishkeel as containing, with the post-town of Narin or Nairn, 8,266 inhabitants. The parish, also called *Innis-Coel*, derives its name from a monastery of which St. Conald Coel was abbot (*c.* 590 AD) when he was killed by pirates. Lewis notes the parish as measuring 24 miles in length, approximately eight miles in width and consisting of 102,815 statute acres (*ibid.*).

Glenties, which in its original Irish form is *Na Gleanntai*, meaning The Glens, is located where two glens and two rivers (the Owenea and Stracashel) meet. It lies at the western edge of the Blue Stack Mountains and is surrounded by mountains on three of its four sides, while the western side of the valley opens into the Atlantic Ocean. Archaeological sites in close proximity to the town include a portal tomb, a standing stone, a promontory fort, several ringforts and several cross-slabs.

The area became part of the baronies of Boylagh and Bannagh in 1609 as part of the Plantation of Ulster. A workhouse was built in Glenties during the Great Famine in 1846, and a 40-bed fever hospital was later added. The Marquis of Conyngham, as landlord, wanted to halve the population of the town in 1847. Only those who could prove title to their land as rent payers were allowed remain. The remainder of the population were given the options of sailing to America on a ship provided or entering the workhouse. Over 40,000 people died or emigrated from County Donegal between 1841 and 1851.

9.4.2 Cartographic Analysis

Ordnance Survey First Edition 1:10,560 1836 (figure 9.7), **Ordnance Survey First Edition 1:2,500** 1900 - 1905 (figures 9.8, 9.9 and 9.10), **Ordnance Survey Third Edition 1:10,560** 1906 - 1907 (figure 9.11)

The wind farm access road will cross the line of two townland boundaries. The grid connection will cross the line of seven townland boundaries. The majority of these townland boundaries take the form of small streams or the relict remains of small stream beds. Research suggests that:

> "*hoards and single finds of Bronze Age weapons, shields, horns, cauldrons and gold personal objects can all be shown to occur on boundaries*" (Kelly 2006, 28).

Several small structures are recorded in the vicinity of Turbine 4 on the historic maps, although all are outside the area of proposed land take. The site visit confirmed these to consist of a dilapidated single-story cottage and two dilapidated out-buildings of no architectural significance. An Ordnance Survey trigonometrical station is recorded north of Turbine 7 on historic cartographic sources and well outside the area of proposed land take. A limekiln is recorded north of the access road leading to Turbine 8 on the First Edition 1:2,500 map and the Third Edition 1:10,560 map and outside the area of proposed land take. There was no evidence of this feature revealed during the walkover survey. The location of Turbines 1 – 8 is recorded as rough pasture or rough pasture with cropping rock on historic cartographic sources.

The location of the proposed substation, its associated access road and the meteorological mast are recorded as unenclosed rough pasture on all Editions of the Ordnance Survey maps. In addition, the location of the proposed turbine delivery route and road widening junction are also recorded as rough pasture on all Editions of the Ordnance Survey maps.

The First Edition 1:2,500 map and the Third Edition 1:10,560 map record a number of vernacular structures, associated farm tracks, Ordnance Survey bench marks, wells, springs, limekilns, *etc.* in the general vicinity of the proposed grid connection. The road along which most of the grid connection will extend is not recorded on the First Edition Ordnance Survey map.

There are no archaeological, architectural or cultural heritage features, with the exception of the above-mentioned townland boundaries, recorded on historic cartographic sources within the proposed development area.

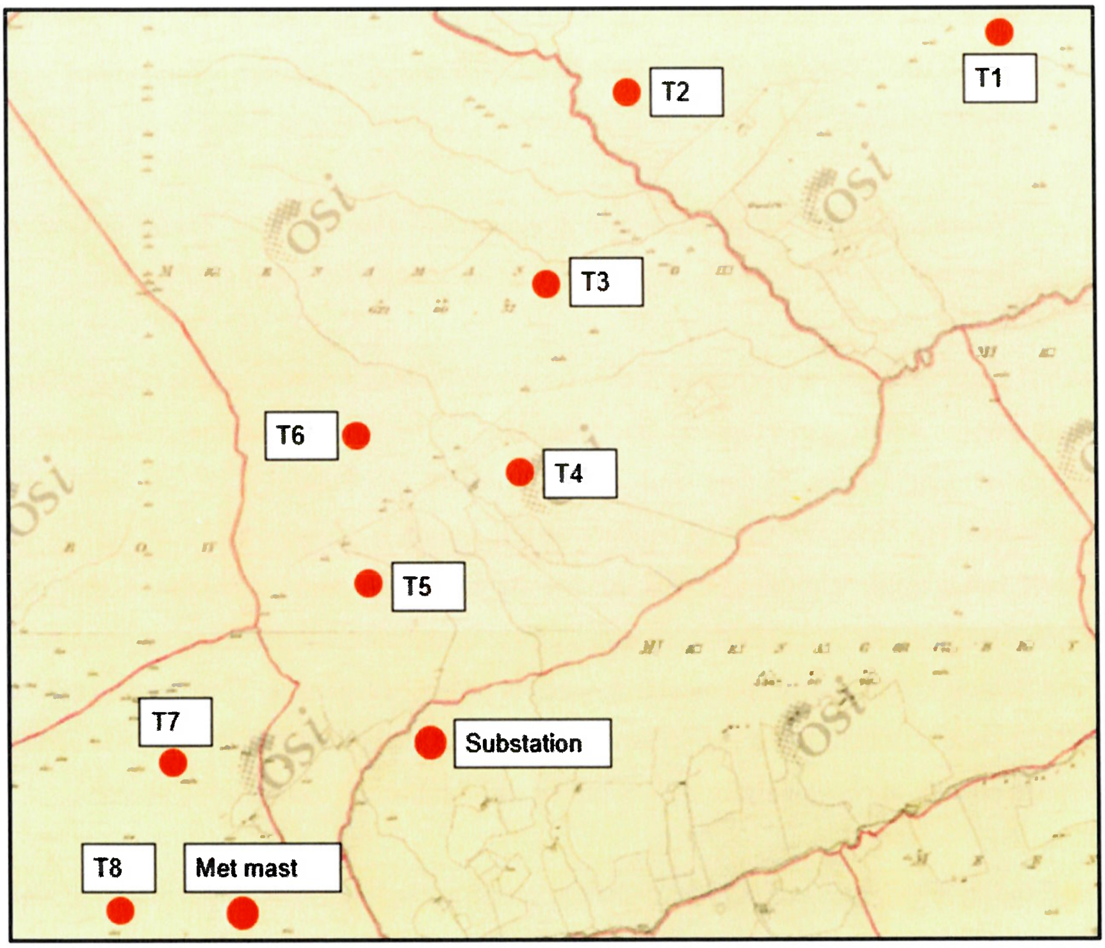

Figure 9.7: Extract from First Edition Ordnance Survey map 1:10,560 (1836), showing location of Turbines 1 – 8, substation and meteorological mast

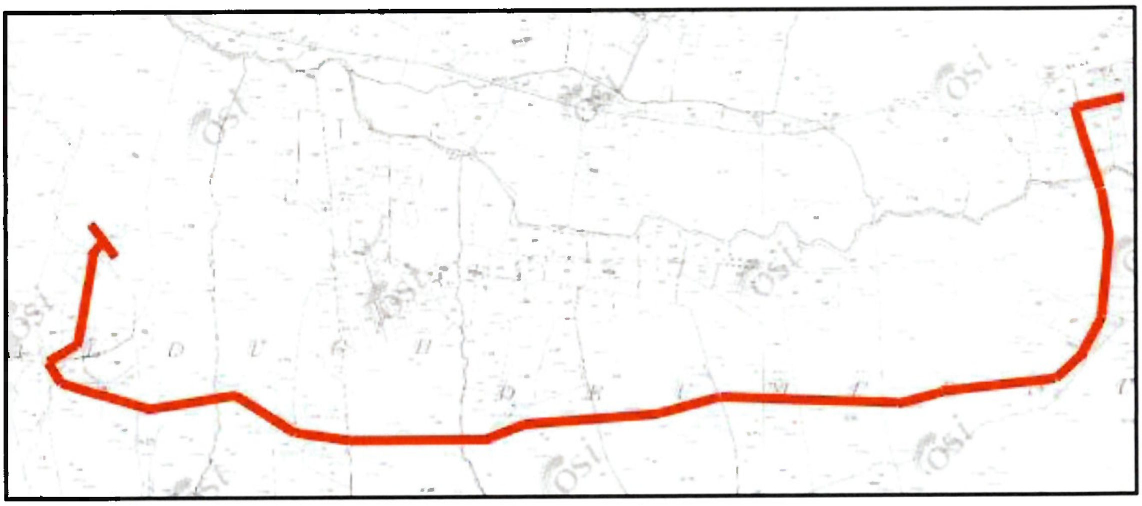

Figure 9.8: Extract from First Edition Ordnance Survey map 1:2,500 (1900 - 1905), showing western end of the grid connection

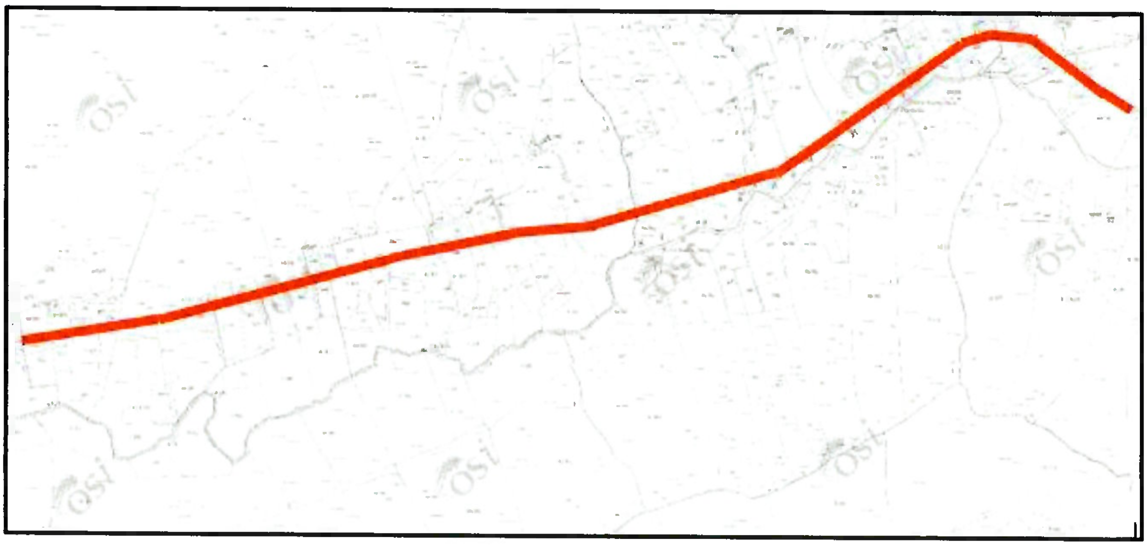

Figure 9.9: Extract from First Edition Ordnance Survey map 1:2,500 (1900 - 1905), showing middle part of the grid connection

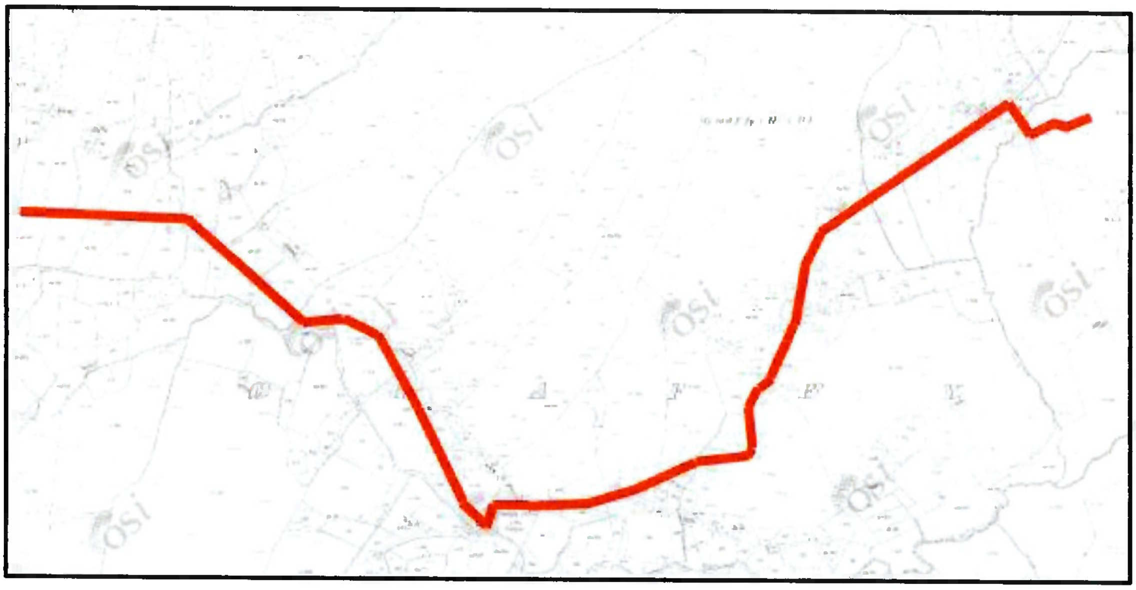

Figure 9.10: Extract from First Edition Ordnance Survey map 1:2,500 (1900 - 1905), showing eastern end of the grid connection

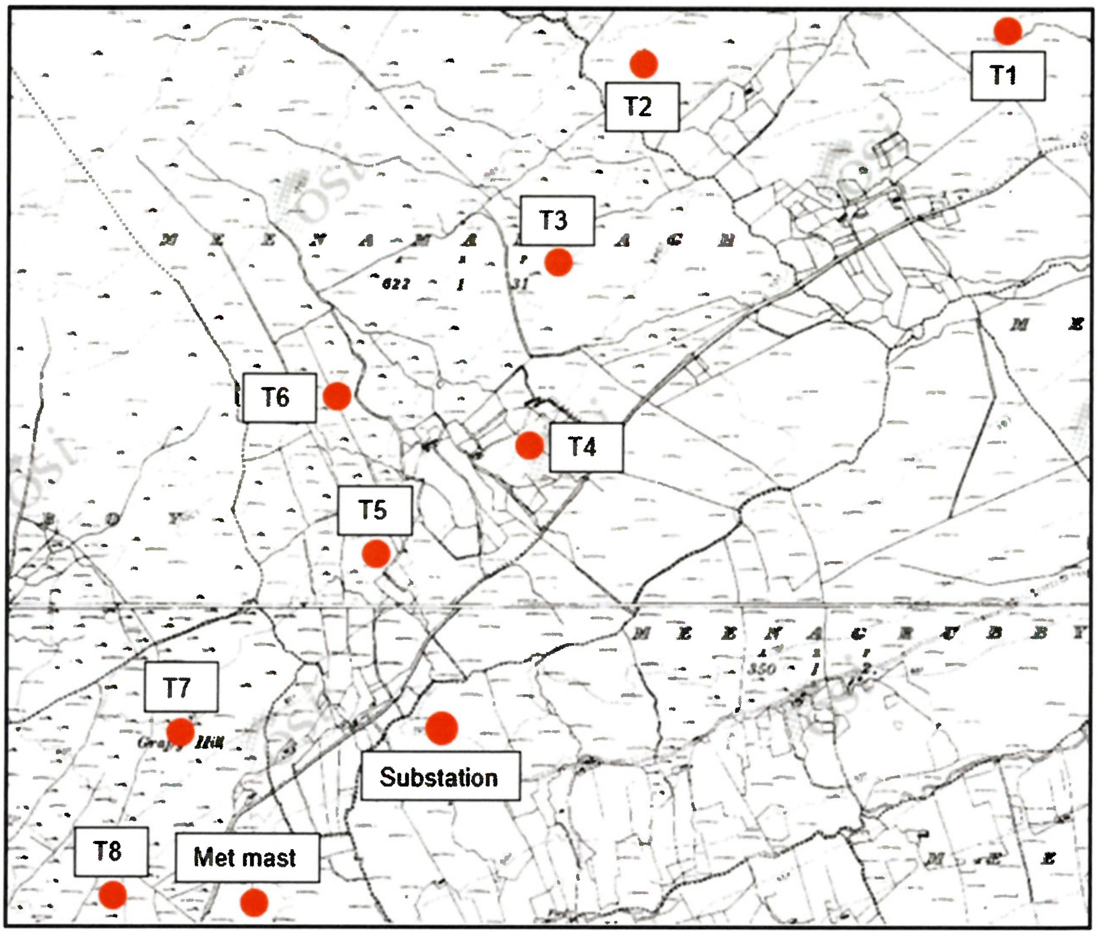

Figure 9.11: Extract from Third Edition Ordnance Survey map 1:10,560 (1906 - 1907), showing location of Turbines 1 – 8 substation and meteorological mast

9.4.3 Aerial Photographs

Aerial photography held by Ordnance Survey Ireland (map.geohive.ie) and Bing aerial photography (www.bing.com/maps) were consulted to look for the presence of archaeological or architectural remains within the proposed development area. The aerial photographs record a similar landscape to that which was noted during the walkover surveys (see **9.4.10 Site Visit** below).

The location of Turbines 1 – 8 and associated access roads are recorded on 1995, 2000 and 2005 aerial photography, as well as more recent Bing aerial photography, as large areas of unenclosed bog.

The location of the substation, its associated access road, the meteorological mast, the turbine delivery route and the road widening junction are all recorded on aerial photography as unenclosed bog or forestry.

The grid connection will mainly be laid along the verge of the existing road network, with exception of the western end where aerial photography records a modern forest plantation and an *in situ* access road.

There was no evidence of any archaeological or architectural features recorded on aerial photography within the proposed development area.

9.4.4 Topographical Files ofthe National Museum of Ireland

Information on artefact finds and excavations from County Donegal is recorded by the National Museum of Ireland. Location information relating to such finds is important in establishing prehistoric and historic activity in the study area.

A wooden pole (National Museum of Ireland Reference: 1966-163) and two wooden beams (National Museum of Ireland References: 1966-161 and 1966-162) were possibly discovered in Graffy townland, 1.2m deep in a bog. National Museum of Ireland Reference: 1966-161 consisted of a piece of dried-out beam measuring 7.5m in length and perforated by a rectangular slot measuring 4cm x 1.5cm. National Museum of Ireland Reference: 1966-162 is recorded as three fragments of a cylindrical piece of solid wood with a pronounced keel. The keel is perforated at approximately 3.5cm intervals by irregularly gouged holes made in a rough hour-glass fashion. These perforations were 2.5cm in maximum length and 1.2cm in average diameter. The maximum length of each fragment was 0.185m, 0.26m and 0.3m respectively and with an average maximum diameter of 8cm. It is recorded in the Topographical Files that a fourth fragment was discovered but that it was allowed to dry out. National Museum of Ireland Reference: 1966-163 is recorded as three pieces of a circular wooden pole. They had maximum lengths of 0.26m, 0.155m and 6.5cm. Their average depth was 3.7cm.

These artefacts are recorded as being found in Graffy townland, but the coordinates noted for their discovery place their find spot in Stralinchy townland (which is the townland located immediately west of Graffy townland and outside the proposed development area). As a result, it is not possible to be precise as to which townland they were discovered in.

9.4.5 Previous Archaeological Fieldwork

Reference to Summary Accounts of Archaeological Excavations in Ireland (www.excavations.ie) confirmed that no fieldwork programmes have been carried out in any townlands located within the proposed development area.

9.4.6 Toponyms

Townland names are an important source in understanding the archaeology, geology, land-use, ownership and cultural heritage of an area (www.logainm.ie).

Table 9.2: Toponyms

Name	Irish	Translation
Banganboy	*An Beangán Búi*	The yellow branch
Dalraghan More	*An Dearachán Mór*	Possibly translates as shining pebbles land
Drumconcoose	*Droim Chon Cuais*	The greyhound's hill of the greyhound's cave
Drumnalough	*Droim an Locha*	Ridge of the lake
Graffy	*An Ghrafaidh*	Grubbed land
Lughveen	*An Liuchmhín*	The wet field
Meenagrubby	*Mín an Ghriobaigh*	Mirey field or misk
Meenamalragh	*Mín na Mallsrath*	Misk of the horse loads
Meenamanragh	*Mín na Manrach*	Misk of the mangers
Stracashel	*Srath Chaisil*	Holm of the cashel or stone fort
Tievereagh	*Taobh Riach*	The grey side

9.4.7 National Monuments

The Department of Culture, Heritage and the Gaeltacht maintains a database on a county basis of National Monuments in State Care: Ownership and Guardianship. The term National Monument is defined in Section 2 of the National Monuments Act (1930) 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*" (www.archaeology.ie).

There are no National Monuments in State Care within the proposed wind farm, substation or meteorological mast or within 5km of the proposed wind farm, substation or meteorological mast.

There are no National Monuments in State Care within the proposed grid connection or within 1km of the proposed grid connection.

There are no National Monuments in State Care within the proposed turbine delivery route and associated road widening or within 1km of the proposed turbine delivery route and associated road widening.

The Department of Culture, Heritage and the Gaeltacht also maintains a database on a county basis of National Monuments with Preservation Orders or Temporary Preservation Orders.

There are no National Monuments with Preservation Orders or Temporary Preservation Orders within the proposed wind farm, substation or meteorological mast or within 5km of the proposed wind farm, substation or meteorological mast.

There are no National Monuments with Preservation Orders or Temporary Preservation Orders within the proposed grid connection or within 1km of the proposed grid connection.

There are no National Monuments with Preservation Orders or Temporary Preservation Orders within the proposed turbine delivery route and road widening junction or within 1km of the proposed turbine delivery route and road widening junction.

There are no World Heritage Sites or sites included in the Tentative List as consideration for nomination to the World Heritage List within the proposed wind farm, substation or meteorological mast or within 5km of the proposed wind farm, substation or meteorological mast.

There are no World Heritage Sites or sites included in the Tentative List as consideration for nomination to the World Heritage List within the proposed grid connection or within 1km of the proposed grid connection.

There are no World Heritage Sites or sites included in the Tentative List as consideration for nomination to the World Heritage List within the proposed turbine delivery route and road widening junction or within 1km of the proposed turbine delivery route and road widening junction.

9.4.8 County Development Plan

9.4.8.1 Archaeological Heritage

County Donegal Development Plan 2018 - 2024

It is an Objective (AH-O-1) of Donegal County Council (County Donegal Development Plan 2018, 138) to:

> "*conserve and protect the County's archaeological heritage for present and future generations*".

It is the Policy (AH-P-1) of Donegal County Council (*ibid.*) to:

> *"protect and enhance the integrity of Archaeological Monuments and their settings and to secure the preservation in-situ of all archaeological monuments included on the Record of Monuments and Places. Preservation by record shall only be considered in exceptional circumstances where the principles of the Department of Arts, Heritage, Gaeltacht and the Islands publication entitled, 'Framework and Principles for the Protection of Archaeological Heritage' can be satisfied*".

It is also the Policy (AH-P-3) of Donegal County Council (*ibid.*, 139) to:

> *"protect the character, settings of and views from National Monuments and Recorded Monuments and to manage development which would be considered to (visually or physically) intrude upon or inhibit the enjoyment of the amenities of these sites*".

Table 8 Appendix 3 of the County Donegal Development Plan (*ibid.*, 195) records *National Monuments in State Ownership or Guardianship* in County Donegal.

There are no National Monuments in State Ownership or Guardianship within the proposed wind farm, substation or meteorological mast or within 5km of the proposed wind farm, substation or meteorological mast.

There are no National Monuments in State Ownership or Guardianship within the proposed grid connection or within 1km of the proposed grid connection.

There are no National Monuments in State Ownership or Guardianship within the proposed turbine delivery route and road widening junction or within 1km of the proposed turbine delivery route and road widening junction.

Table 9 Appendix 3 of the County Donegal Development Plan (*ibid.*, 196-197) records the *Historic Graveyards* (*in guardianship of Donegal County Council*) in County Donegal.

There are no Historic Graveyards (in guardianship of Donegal County Council) within the proposed wind farm, substation or meteorological mast or within 5km of the proposed wind farm, substation or meteorological mast.

There are no Historic Graveyards (in guardianship of Donegal County Council) within the proposed grid connection or within 1km of the proposed grid connection.

There are no Historic Graveyards (in guardianship of Donegal County Council) within the proposed turbine delivery route and road widening junction or within 1km of the proposed turbine delivery route and road widening junction.

There are no Historic Towns as listed in the County Donegal Development Plan (*ibid.*, 138) within the proposed wind farm, substation or meteorological mast or within 5km of the proposed wind farm, substation or meteorological mast.

There are no Historic Towns as listed in the County Donegal Development Plan (*ibid.*) within the proposed grid connection or within 1km of the proposed grid connection.

There are no Historic Towns as listed in the County Donegal Development Plan (*ibid.*) within the proposed turbine delivery route and road widening junction or within 1km of the proposed turbine delivery route and road widening junction.

9.4.8.2 Architectural Heritage

County Donegal Development Plan 2018 - 2024

It is an Objective (BH-O-1) of Donegal County Council (*ibid.*, 135) to:

> "*preserve, protect, enhance and record the architectural heritage of the County*".

It is the Policy (BH-P-1) of Donegal County Council (*ibid.*, 136) to:

> "*conserve and protect all structures (or parts of structures) and sites contained in the Record of Protected Structures that are of special architectural, historic, archaeological, artistic, cultural, scientific, social or technical interest*".

Tables 10 - 14 Appendix 3 of the County Donegal Development Plan (*ibid.*, 198-263) contain the *Record of Protected Structures* for County Donegal.

There are no Protected Structures within the proposed wind farm, substation or meteorological mast or within 5km of the proposed wind farm, substation or meteorological mast.

There are no Protected Structures within the proposed grid connection or within 1km of the proposed grid connection.

There are no Protected Structures within the proposed turbine delivery route and road widening junction or within 1km of the proposed turbine delivery route and road widening junction.

There are no Heritage Towns as listed in the County Donegal Development Plan (*ibid.*, 134) within the proposed wind farm, substation or meteorological mast or within 5km of the proposed wind farm, substation or meteorological mast.

There are no Heritage Towns as listed in the County Donegal Development Plan (*ibid.*) within the proposed grid connection or within 1km of the proposed grid connection.

There are no Heritage Towns as listed in the County Donegal Development Plan (*ibid.*) within the proposed turbine delivery route and road widening junction or within 1km of the proposed turbine delivery route and road widening junction.

There are no Architectural Conservation Areas or Proposed Architectural Conservation Areas listed in the County Donegal Development Plan.

9.4.8.3 Cultural Heritage

County Donegal Development Plan 2018 - 2024

The Donegal Gaeltacht, covering a third of the county and encompassing an area of 1,502 km^2, is the second largest of the seven Gaeltacht areas in Ireland. It contains a population of 24,744, *i.e.* 24.5% of the total Gaeltacht population in Ireland (*ibid.*, 170).

It is an Objective (CCG-O-8) of Donegal County Council (*ibid.*, 173) to:

> "*sustain the Irish Language as a living community language in the strongest Gaeltacht areas, to strengthen the use of the language elsewhere, and to protect the cultural heritage of, and facilitate the sustainable social, physical and economic development, of the Gaeltacht*".

The proposed windfarm, substation, meteorological mast, grid connection, turbine delivery route and road widening junction will all be located inside the Gaeltacht as defined in Map 11.1 (Community, Culture and the Gaeltacht) of the County Donegal Development Plan (Donegal County Council, 2018).

9.4.9 National Inventory of Architectural Heritage

9.4.9.1 Building Survey

The National Inventory of Archaeological Heritage maintains a non-statutory register of buildings, structures *etc*. recorded on a county basis (www.buildingsofireland.ie).

It is the Policy (BH-P-4) of Donegal County Council (*ibid*., 136) to:

> "*ensure the repair, reuse and appropriate refurbishment of vernacular and/or historic buildings, which make a positive contribution to the built heritage of the area including those as referred to on the National Inventory of Architectural Heritage*".

There are no structures recorded on the NIAH within the proposed wind farm, substation or meteorological mast or within 5km of the proposed wind farm, substation or meteorological mast.

There are no structures recorded on the NIAH within the proposed grid connection or within 1km of the proposed grid connection.

There are no structures recorded on the NIAH within the proposed turbine delivery route and road widening junction or within 1km of the proposed turbine delivery route and road widening junction.

9.4.9.2 Historic Gardens and Designed Landscapes

The National Inventory of Archaeological Heritage also maintains a non-statutory register of historic gardens and designed landscapes (www.buildingsofireland.ie).

It is the Policy (BH-P-18) of Donegal County Council (*ibid*., 137) to:

> "*preserve the integrity of Historic Gardens and Designed Landscape sites in County Donegal identified in the National Inventory of Architectural Heritage*".

There are no historic gardens or designed landscapes recorded on the NIAH within the proposed wind farm, substation, meteorological mast, grid connection, turbine delivery route and road widening junction or within 1km of the proposed wind farm, substation, meteorological mast, grid connection, turbine delivery route and road widening junction.

9.4.10 Site Visit

Field inspection is necessary to determine the extent, character and condition of archaeological, architectural and cultural heritage features, and can also lead to the identification of previously unrecorded or suspected sites and portable finds through topographical observation and local information.

Site visits took place on 24th April 2019, 26th February 2020 and 2nd December 2020. Areas of proposed land take associated with the eight no. turbine wind farm, substation and meteorological mast were walked and visually assessed. The proposed grid connection along the line of a public road was assessed by means of a detailed windshield survey, while the grid connection on private land at the western end of the scheme was walked and visually assessed.

Weather conditions were dry and bright on 24th April 2019, snowy and cold on 26th February 2020 and dry and cold on 2nd December 2020.

Turbine 1: Located in modern forestry with poor views in all directions. Access road would be across unenclosed upland bog.

Turbine 2: Exposed, unenclosed, undulating upland bog. Good views south and poor north, west and east. Access road would be across upland bog with occasional rock outcropping.

Turbine 3: Unenclosed upland bog with occasional rock outcropping. Good views south and poor north, west and east. Access road would be across upland bog with occasional rock outcropping.

Turbine 4: Located in the environs of a dilapidated cottage and two dilapidated outbuildings and surrounding trees. Land take would be in bog with good views south and east and poor north and west. Access road would be across undulating unenclosed bog.

Turbine 5: Located north west of a conifer plantation in an area of open bog. Good views south, moderate north and west and poor east due to the conifer plantation. Access would be across a conifer plantation and open bog.

Turbine 6: Very exposed, unenclosed upland bog with good views to south and east, and moderate north and west. Access road would be across undulating exposed upland bog.

Turbine 7: Very exposed, unenclosed upland bog with occasional rock outcropping. Good views to south and west, moderate east and poor north. Access road would be across undulating exposed upland bog.

Turbine 8: Exposed, unenclosed upland bog with very occasional rock outcropping. Good views to south and west, moderate east and poor north. Access road would be across exposed upland bog.

Substation: Unenclosed generally flat bog with good views in all directions. Access road would be across generally flat unenclosed bog.

Meteorological mast: To be located in the same position as the existing temporary meteorological mast. Unenclosed, undulating disturbed bog. Good views to west and south, moderate east and poor north. Access would be off an existing farm track..

No archaeological, architectural or cultural heritage features were revealed within the proposed wind farm, substation or meteorological mast as a result of carrying out the walkover surveys.

The underground grid connection will largely be laid along a local public and private road. Occasional houses and modern forestry were noted either side of the public road.
The western end of the proposed grid connection will be laid on private land, and the walkover survey noted an existing 4m to 5m wide compacted access road with conifer plantations either side.

No archaeological, architectural or cultural heritage features were revealed within the proposed grid connection as a result of carrying out the windshield survey and walkover survey.

Bogs or waterlogged areas, such as those noted above, frequently contain previously unrecorded remains and often form important archaeological landscapes. Waterlogged conditions provide an anaerobic environment which preserves organic remains and features such as wooden trackways or toghers. The practice of laying down trackways or causeways across wet areas and bogs to facilitate movement is known from as early as the 4th millennium BC. Trackways vary in form from a localised use of brushwood to large-scale linear features substantial enough to carry wheeled vehicles. In addition, monuments such as crannogs, *fulachta fiadh* and sites of votive offering are frequently found in or near wet, waterlogged regions.

Areas of present day marginal land use and bog may not always have been of such inferior quality or of little practical use. Field walls and stone cairns have been discovered in County Donegal under bog in areas which would originally have been well-drained, light soils suitable for cultivation (Lacy 1983, 50).

A number of narrow and shallow watercourses were noted during the walkover surveys within the land take and general environment of the proposed development. Rivers and streams have been favoured from prehistoric times for their proximity to rich food sources, and are often represented by habitation sites and middens. Rivers were also important areas of activity serving as routeways, boundaries, defences and ritual sites. Riverbanks and streams are considered areas of high archaeological potential, containing features such as *fulachta fiadh*, fords, ancient bridging sites, mills, longphorts and other habitation sites, and also produce archaeological artefacts such as logboats, organic material or votive offerings of swords, axeheads and other archaeological objects.

Plate 9.1: General location of Turbine 1, looking east

Plate 9.2: Location of Turbine 2, looking east

Plate 9.3: Location of Turbine 3, looking north

Plate 9.4: Location of Turbine 4, looking east

Plate 9.5: Location of Turbine 5, looking east

Plate 9.6: Location of Turbine 6, looking east

Plate 9.7: Location of Turbine 7, looking south

Plate 9.8: Location of Turbine 8, looking south

Plate 9.9: Location of substation, looking south

Plate 9.10 Location of western end of grid connection along private road, looking east

9.4.11 Summary

There are no protected archaeological, architectural or cultural heritage features within the land take of the proposed wind farm, substation, meteorological mast, grid connection, turbine delivery route or associated road widening. There are 11 RMP sites within the wind farm, substation and meteorological mast 5km study area. There is one RMP site within the grid connection 1km study area. There are no RMP sites within the turbine delivery route 1km study area. There are no National Monuments in State Care within the wind farm, substation and meteorological mast 5km study area, the grid connection 1km study area or the turbine delivery route 1km study area. There are no National Monuments with Preservation Orders or Temporary Preservation Orders within the wind farm, substation and meteorological mast 5km study area, the grid connection 1km study area or the turbine delivery route 1km study area. There are no World Heritage Sites or sites included in the Tentative List as consideration for nomination to the World Heritage List within the wind farm, substation and meteorological mast 5km study area, the grid connection 1km study area or the turbine delivery route 1km study area. There are no Historic Graveyards within the wind farm, substation and meteorological mast 5km study area, the grid connection 1km study area or the turbine delivery route 1km study area. There are no Historic Towns within the wind farm, substation and meteorological mast 5km study area, the grid connection 1km study area or the turbine delivery route 1km study area. There are no Protected Structures within the wind farm, substation and meteorological mast 5km study area, the grid connection 1km study area or the turbine delivery route 1km study area. There are no Heritage Towns within the wind farm, substation and meteorological mast 5km study area, the grid connection 1km study area or the turbine delivery route 1km study area. There are no Architectural Conservation Areas or Proposed Architectural Conservation Areas listed in the County Donegal Development Plan. There are no structures recorded on the NIAH within the wind farm, substation and meteorological mast 5km study area, the grid connection 1km study area or the turbine delivery route 1km study area. There are no historic gardens or designed landscapes recorded on the NIAH within the wind farm, substation, meteorological mast, grid connection or turbine delivery route 1km study area. There are no archaeological, architectural or cultural heritage features recorded on historic cartographic sources within the proposed development area. The wind farm access road will cross the line of two townland boundaries and the grid connection will cross the line of seven townland boundaries as recorded on historic cartographic sources. There was no evidence of any archaeological or architectural features recorded on aerial photography within the proposed development area. There was an entry for a townland possibly located within the proposed development area recorded in the Topographical Files of the National Museum of Ireland. Reference to Summary Accounts of Archaeological Excavations in Ireland confirmed that no fieldwork programmes have been carried out in any townlands located within the proposed development area. No archaeological, architectural or cultural heritage features were revealed within any areas of proposed land take as a result of carrying out three walkover surveys and windshield survey. The windfarm, substation, meteorological mast, grid connection, turbine delivery route and road widening junction will all be located inside the Donegal Gaeltacht.

9.5 ASSESSMENT OF LIKELY EFFECTS

Elements of the proposed development with the potential to impact on archaeological, architectural or cultural heritage remains are construction of the turbine bases and hardstand areas, access roads, grid connection, substation, meteorological mast, road widening and associated activities. Development of these facilities will involve the mechanical excavation of topsoil and overburden down to and through geologically deposited strata at their identified locations. Operational phase effects can include visual impacts resulting from the presence of turbines in a landscape. The decommissioning phase will result in the removal of wind farm infrastructure and is likely to result in an improvement on the archaeological resource.

As a result of carrying out this assessment, the following potential archaeological, architectural and cultural heritage direct, indirect, construction, operational, decommissioning, cumulative and residual effects have been assessed:

9.5.1 Construction Phase Effects

9.5.1.1 Archaeological Resource

- There are no Recorded Monuments or additional statutorily protected archaeological remains within the proposed wind farm, substation, meteorological mast, grid connection or turbine delivery route. As a result, it is considered there will be no direct or indirect construction phase effect on the recorded archaeological resource.

- There are 11 RMP sites within the wind farm, substation and meteorological mast 5km study area and one RMP site within the grid connection 1km study area. It is considered there will be a permanent direct imperceptible construction phase effect on any previously unrecorded archaeological remains that may exist within the development area.

- It is considered there will be a permanent direct imperceptible construction phase effect on the eight no. townland boundaries that will be impacted on by the proposed development.

9.5.1.2 Architectural Resource

- There are no Protected Structures, Architectural Conservation Areas, NIAH structures or any additional statutorily protected architectural features within the proposed wind farm, substation and meteorological mast or the wind farm, substation and meteorological mast 5km study area. There are no Protected Structures, Architectural Conservation Areas, NIAH structures, NIAH historic gardens or any additional statutorily protected architectural features within the proposed grid connection or turbine delivery route or the grid connection and turbine delivery route 1km study areas. As a result, it is considered there will be no direct or indirect construction phase effect on the architectural resource.

9.5.1.3 Cultural Heritage Resource

- It is considered there will be no direct or indirect construction phase effect on the cultural heritage resource.

9.5.2 Operational Phase Effects

9.5.2.1 Archaeological Resource

- It is considered there will be at worst a long-term reversible imperceptible operational phase visual effect on the 11 Recorded Monuments located within the wind farm, substation and meteorological mast 5km study area.

- It is considered there will be no operational phase effect on the one Recorded Monument located within the grid connection 1km study area.

9.5.2.2 Architectural Resource

- It is considered there will be no operational phase effect on the architectural resource.

9.5.2.3 Cultural Heritage Resource

- It is considered there will be no operational phase effect on the cultural heritage resource.

9.5.3 Decommissioning Phase Effects

- It is considered there will be no decommissioning phase effect on the archaeological, architectural or cultural heritage resource.

9.5.4 Cumulative Effects

Cumulative effects are defined as:

> "*The addition of many minor or significant effects, including effects of other projects, to create larger, more significant effects*" (Environmental Protection Agency 2017, 52).

- It is considered there will be no cumulative construction phase effect on the archaeological, architectural or cultural heritage resource.

- It is considered there will be no cumulative operational phase effect on the archaeological, architectural or cultural heritage resource.

9.5.5 Do Nothing Effects

- If the proposed development were not to proceed, there would be no effect on the archaeological, architectural or cultural heritage resource.

9.5.6 Interactive Effects

- It is considered there will be no interactive effect on the archaeological, architectural or cultural heritage resource.

9.5.7 Risk of Accidents

- It is considered there will be no effect on the archaeological, architectural or cultural heritage resource as a result of any unplanned accidents.

9.5.8 Worst Case Effects

- It is considered under a worst case scenario there would be a permanent direct construction phase effect on any previously unrecorded archaeological remains that may exist within the development area.

9.6 RECOMMENDATIONS AND MITIGATION

9.6.1 Mitigation Measures

- There are 11 RMP sites within the wind farm, substation and meteorological mast 5km study area and one RMP site within the grid connection 1km study area. In addition, bogs are recognised as being areas of archaeological potential and often contain previously unrecorded well-preserved below-ground archaeological remains. As such, it is proposed that archaeological monitoring of all groundworks associated with construction of the wind farm, substation, meteorological mast, grid connection, turbine delivery route and road widening junction be carried out. Monitoring will be carried out under licence to the Department of Culture, Heritage and the Gaeltacht and the National Museum of Ireland. Provision will be made for the full excavation and recording of any archaeological features or deposits that may be exposed during monitoring.
- It is proposed that written and photographic records be created of the eight no. townland boundaries that will be impacted on. The written and photographic records will be created in advance of groundworks commencing on site.

9.6.2 Monitoring Measures

- With the exception of the mitigation measures recommended in **Section 9.6.1**, there are no future monitoring requirements.

9.7 RESIDUAL EFFECTS

9.7.1 Archaeological Resource

- It is considered there will be at worst a residual long-term reversible imperceptible visual effect on the 11 Recorded Monuments located within the wind farm, substation and meteorological mast 5km study area.

9.7.2 Architectural Resource

- It is considered there will be no residual effect on the architectural resource.

9.7.3 Cultural Heritage Resource

- It is considered there will be no residual effect on the cultural heritage resource.

9.8 MICROSITING

- A 20m micro-siting buffer zone will be required to facilitate turbine construction. Due to the recommended monitoring of all ground works, micro-siting with a 20m tolerance will have no adverse effect on the archaeological, architectural or cultural heritage resource.

9.9 CONCLUSION

It is considered there will be no direct or indirect construction phase effect on the recorded archaeological, architectural or cultural heritage resource. It is considered there will be a permanent direct imperceptible construction phase effect on any previously unrecorded archaeological remains that may exist within the development area. It is considered there will be a permanent direct imperceptible construction phase effect on eight no. townland boundaries that will be impacted on by the proposed development.

It is proposed that archaeological monitoring of all groundworks associated with construction of the wind farm, substation, meteorological mast, grid connection, turbine delivery route and road widening be carried out. Monitoring will be carried out under licence to the Department of Culture, Heritage and the Gaeltacht and the National Museum of Ireland. Provision will be made for the full excavation and recording of any archaeological features or deposits that may be exposed during monitoring. It is proposed that written and photographic records be created of the eight no. townland boundaries that will be impacted on. The written and photographic records will be created in advance of groundworks commencing on site.

It is considered there will be at worst a residual long-term reversible imperceptible visual effect on the 11 Recorded Monuments located within the wind farm, substation and meteorological mast 5km study area. It is considered there will be no residual effect on the architectural or cultural heritage resource.

It is considered there will be no decommissioning phase effect on the archaeological, architectural or cultural heritage resource.

It is considered there will be no cumulative construction or operational phase effect on the archaeological, architectural or cultural heritage resource.

Due to the recommended monitoring of all ground works, micrositing will have no adverse effect on the archaeological, architectural or cultural heritage resource.

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www.heritagemaps.ie	The Heritage Council
www.logainm.ie	Placenames Database of Ireland
map.geohive.ie	Ordnance Survey Ireland aerial photography

10(i) Terrestrial Biodiversity

Contents

10(i) Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) identifies, describes and assesses in an appropriate manner, the direct and indirect significant effects of the proposed Graffy Windpark on biodiversity, in respect of terrestrial flora and fauna.

As noted in the EC (2013) *Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment*, biological diversity or 'biodiversity' is one of the key terms in conservation, encompassing the richness of life and the diverse patterns it forms. The 1992 UN Convention on Biological Diversity defines biological diversity as 'the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems'.

Ecological Impact Assessment (EcIA) is a process of identifying, quantifying and evaluating the potential and likely significant effects of a proposed project on ecological features, where ecological features are the species, habitats and biodiversity components of ecosystems that have the potential to be affected by the Graffy Windfarm Project.

As biodiversity, considered in its entirety, comprises an enormous amount of species and habitats, ecological assessment is typically divided into specialist subject areas. The Biodiversity: Flora and Fauna chapter of this EIAR contains a description of the terrestrial flora and faunal features and designated sites within a zone of influence (ZoI) of the Graffy Windpark Project, followed by an assessment of the potential and likely significant effects of the Proposed Project on terrestrial floral and faunal features and designated sites.

The wider Biodiversity chapter contains information on different specialist subject areas of ecology, and has been presented in five different sections, written by a number of authors.

The remainder of the wider Biodiversity chapter has been broken down into the following sub-sections:

- 10 (ii): Avi-fauna – Woodrow Sustainable Solutions
- 10 (iii): Bats – Woodrow Sustainable Solutions
- 10 (iv): Aquatic Ecology – Paul Johnston Associates Ltd.
- 10 (v): Freshwater Pearl Mussel – RPS

Each specialist sub-section discusses the relevant biodiversity features and designated sites in turn under each of the sub-headings of:

- Methodology
- Receiving Environment
- Impact Assessment
- Remedial and Mitigation Measures
- Residual Impacts
- Monitoring

'*Methodology*' describes the survey and assessment methodology used by each specialist in compiling their component part of the chapter.

'*Receiving Environment*' describes the receiving environment and comprises a description of the relevant biodiversity features within the zone of influence of the Proposed Project.

'*Impact Assessment*' outlines the potential for impacts upon relevant biodiversity features as a result of the construction and operation of the Proposed Project at each phase and cumulatively, and determines whether or not those potential impacts which have been identified are likely. This section then predicts the magnitude of potential effects on relevant biodiversity features and determines whether or not they are significant in the absence of mitigation.

'*Remedial and Mitigation Measures*' describes measures envisaged to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on relevant biodiversity features within the zone of influence of the Proposed Project.

'*Residual Impacts*' predicts the residual impact upon relevant biodiversity features within the zone of influence of the Proposed Project, after having taken avoidance, remedial or counterbalancing mitigation measures into account.

'*Monitoring*' concludes the sub-divided assessments by describing, where relevant and applicable, any proposals for monitoring. Monitoring provides a mechanism to detect unexpected mitigation failures, and verify that the Proposed Project is being constructed and/or operated as intended. Monitoring can result in actions, activities or operations being adapted or adjusted to ensure continued compliance with conditions of consent.

In addition, a Natura Impact Statement (NIS) has been prepared on behalf of Cuilfeach Teoranta in respect of the application for development consent in relation to the Graffy Windpark Project. The NIS has been submitted so as to enable the competent authorities to carry out the assessments required under the Habitats Directive and Irish law.

10(i).1 Methodology

10(i).1.1 Desktop Review

The National Biodiversity Data Centre (NDBC) is a national organisation that collates, manages, analyses and disseminates data on Ireland's biodiversity. It is funded by the Heritage Council and the Department of Culture, Heritage and the Gaeltacht. The NBDC provides access to all validated biodiversity data through Biodiversity Maps, the on-line biodiversity data portal.

Biodiversity records and full species accounts can be viewed and scrutinised through an interactive Biodiversity Maps portal. This is a tool that can be used to help make a preliminary assessment of biodiversity issues when considering site-specific developments. The chosen search area using the NBDC search tool was customised in order to capture all terrestrial biodiversity records within $10km^2$ surrounding the Graffy Windfarm Project. Online searches were undertaken in August 2020. The purpose of this task was to capture any records of protected species or species of natural heritage importance in proximity to the proposed site boundary. The zone of influence of the Proposed Project on terrestrial biodiversity features does not extend further than this, as pressures of the proposed development will dominate effects on terrestrial biodiversity features beyond the limits of the Application Site.

A National Parks and Wildlife Service (NPWS) data set of Annex I habitats and Flora Protection Order (2015) plant species was reviewed to check for any records at the site of the Proposed Project.

10(i).1 .2Flora and Habitat Survey

A habitat survey was first conducted on 8th September 2020, with further survey undertaken in February 2021. The survey was undertaken in accordance with the Heritage Council's *Best Practice Guidance for Habitat Survey and Mapping* (Smyth *et al.*, 2011). These surveys were undertaken in accordance with the Heritage Council's Best Practice Guidance for Habitat Survey and Mapping. All habitats were mapped and categorised in accordance with the Heritage Council's *Guide to Habitats in Ireland* (Fossitt, 2000). A search was undertaken for protected and invasive flora species. Georeferenced aerial photographs were used as an aid to mapping habitats.

10(i).1.1.3 Protected Species

The habitat survey was also extended to include further information on the potential of the habitats present to support terrestrial species by law or of natural heritage importance. This aspect of the survey was conducted with regard to best practice guidelines, in particular the National Roads Authority guidance on

Ecological surveying techniques for protected flora and fauna during the planning of National Road Schemes (NRA, 2008).

All visible signs of mammals were recorded, and the site visually assessed, in particular for potential breeding or resting areas for protected mammal species. Notes were taken on tracks and signs of protected species during the surveys where or if this arose. The suitability of habitats for protected species was also assessed using expert judgement in combination with the survey results and desktop assessment.

10(i).2 Ecological Valuation and Assessment

Likely significant effects are predicted on the basis of the Project Description described in EIAR Chapter 2. The information gathered from consultation, scoping and stakeholder feedback; the desk study and suite of targeted ecological field surveys has been used to prepare an EcIA of the Graffy Windpark Project upon the identified terrestrial biodiversity features. The EcIA was undertaken in accordance with the following guidelines which were used to derive valuation and assessment criteria as set out in

Table 10(i)-**1** and Table 10(i)-2.

Section 1.3.4 of the European Commission's *Guidance on the preparation of the Environmental Impact Assessment Report (Directive 2011/92/EU as amended by 2014/52/EU)* (EC, 2017) provides advice and guidance on integrating biodiversity considerations into EIA. It further refers to EC guidance on integrating climate change and biodiversity into EIA and CIEEM guidance for conducting ecological impact assessment (see below).

Section 4 of the European Commission's *Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment* (EC, 2013) provides advice and guidance on integrating climate change and biodiversity into EIA.

Section 3.7.3 of the draft Environmental Protection Agency's *Guidelines on the Information to be contained in Environmental Impact Assessment Reports* (EPA, 2017) note under Figure 3.5 therein that "*where more specific definitions exist within a specialised factor or topic e.g. biodiversity, these should be used in preference to these generalised definitions*".

The valuation and impact assessment for terrestrial floral and faunal biodiversity has been undertaken following the methodology set out in the Chartered Institute of Ecology and Environmental Management's *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal* and Marine (CIEEM, 2018); and with reference to Transport Infrastructure Ireland's *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (NRA, 2009); EPA (2017); and BS 42020:2013 Biodiversity: Code of practice for planning and development (BSI, 2013).

CIEEM (2018) guidelines complement EPA (2017) guidelines when describing the nature of effects on biodiversity features:

Positive or negative: Positive and negative impacts/effects are determined according to whether the change is in accordance with nature conservation objectives and policy e.g. improves the quality of the environment or reduces the quality of the environment (*Quality of Effects*, EPA 2017);

Extent: The spatial or geographical area over which the impact/effect may occur (*Extent and Context of Effects*, EPA 2017);

Magnitude: 'Magnitude' refers to size, amount, intensity and volume. It should be quantified if possible and expressed in absolute or relative terms (*Duration and Frequency of Effects*, EPA, 2017);

Duration: 'Duration' is defined in relation to ecological characteristics as well as human timeframes. Five years, which might seem short-term in the human context or that of other long-lived species, would span at least five generations of some invertebrate species. The duration of an activity may differ from the duration of the resulting effect caused by the activity. Effects may be described as short, medium or long-term and permanent or temporary. Short, medium, long-term and temporary will need to be defined in months/years (*Duration and Frequency of Effects*, EPA, 2017);

Frequency and timing: The number of times an activity occurs will influence the resulting effect. The timing of an activity or change may result in an impact if it coincides with critical life-stages or seasons (*Duration and Frequency of Effects*, EPA, 2017), and

Reversibility: An irreversible effect is one from which recovery is not possible within a reasonable timescale or there is no reasonable chance of action being taken to reverse it. A reversible effect is one from which spontaneous recovery is possible or which may be counteracted by mitigation. In some cases, the same activity can cause both reversible and irreversible effects (*Duration and Frequency of Effects*, EPA, 2017).

EcIA is based upon a source-pathway-receptor model, where the source is defined as the individual elements of the Proposed Project 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 receptor is 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.

EC (2017) advises that assessment of significance should be based on clear and unambiguous criteria. 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. Conservation objectives may be specific (e.g. for a designated site) or broad (e.g. national/local nature conservation policy) or more wide-ranging (enhancement of biodiversity). Effects can be considered significant at a wide range of scales from international to local";*

and

> *"an effect that is sufficiently important to require assessment and reporting so that the decision maker is adequately informed of the environmental consequences of permitting a project. A significant effect is a positive or negative ecological effect that should be given weight in judging whether to authorise a project: it can influence whether permission is given or refused and, if given, whether the effect is important enough to warrant conditions, restrictions or further requirements such as monitoring".*

British Standard 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.

Table 10(i)-**1** sets out a geographic frame of reference and criteria for valuing ecological features.

Table 10(i)-**2** sets out criteria for predicting magnitudes of effect. These tables have been prepared with due regard to EC, CIEEM, EPA and NRA guidelines described above.

Significant impacts are those with effects which require avoidance, reduction or counterbalancing measures to mitigate or offset their adverse effects. In this context, it should be noted that likely significant effects on designated European sites are considered separately in the Natura Impact Statement submitted with the application for permission. Beneficial effects do not require mitigation measures as their effects are positive.

Table 10(i)-1 Valuation Criteria for Biodiversity Features

Value	Criteria
International	• 'European Sites' including Special Areas of Conservation (SAC), candidate Special Areas of Conservation (cSAC) & Special Protection Areas (SPA) • Resident or regularly occurring populations (assessed to be important at the international 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 Sites • World Heritage Sites • Sites hosting significant populations of species under the Bonn Convention • Sites hosting significant populations of species under the Berne Convention
National	• Wildlife Refuge for species protected under the Wildlife Acts • 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 • Natural Heritage Areas (NHA) or proposed (p)NHA • National Nature Reserves (NNR) • Marine Nature Reserve (MNR)
Co unty	• Sites listed as part of the Ecological Network in the County Development Plan (CDP) • Areas subject to a Tree Preservation Order in a CDP • Resident or regularly occurring populations (assessed to be important at the County level) of the following

Value	*Criteria*
	➢ 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 (Northern Ireland) Order 1985 (as amended); and/or ➢ Species listed on the relevant Red Data list • Sites containing areas of the habitat types listed in Annex I of the Habitats Directive that do not satisfy the criteria for valuation as of International or National importance • Regionally important populations of species or viable areas of semi-natural habitats or natural heritage features identified in a Biodiversity Action Plan (BAP) or County Development Plan (CDP) prepared for an administrative area • Sites containing natural habitat types with high biodiversity in a regional context and a high degree of naturalness, or populations of species that are uncommon within the County
Local (Higher)	• Locally important populations of priority species or habitats or features of natural heritage importance identified in a BAP, if this has been prepared • Key features of local value, e.g.: – 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 that maintain links and function as ecological corridors between key features of local value
Local (Lower) / Site	• Sites containing small areas of semi-natural habitats that are of limited local importance • sites containing areas of highly modified habitats

Value	Criteria
	• sites containing local populations of species that are common and not of conservation value • Sites that are used by protected species or species of conservation value as part of their territories but which do not contain the breeding or resting places of these species • Sites that do not maintain links or do not function as ecological corridors between key features of local value

Table 10(i)-2 Magnitudes of Effect upon Biodiversity Features

Magnitude of Effect	Criteria
Major adverse	• Adverse Effect upon Integrity of a European site • Loss of or permanent damage to any part of a site of international or national importance • Loss of a key component or key feature of a site of regional importance • Decline in favourable conservation status (FCS) or condition (FCC) of a legally protected species at County value • Causing of an offence under European Directives or domestic transposing legislation
Moderate adverse	• Temporary impacts to key features of a site of international or national importance, but no permanent damage or loss of FCS/FCC • Permanent impacts to any part of a site of County value • Permanent loss of a key feature of local importance (higher value) where a feature is important for and supports other features of value • Causing of an offence under domestic legislation

Magnitude of Effect	Criteria
Minor adverse	• Temporary impacts to any part of a site of County value • Temporary loss of a feature of local importance (lower or higher value) where a feature is not important for and supports other features of value
Negligible	• No impacts above a *de minimis* threshold on identified biodiversity features • Beneficial and adverse impacts balance such that resulting impact has no overall affect upon feature.
Minor beneficial	• A small but clear and measurable gain in general wildlife interest, e.g. small-scale new habitats of wildlife value created where none existed before or where the new habitats exceed in area the habitats lost.
Moderate beneficial	• Larger new scale habitats (e.g. net gains > 1 ha in area) created leading to significant measurable gains helping to achieve relevant objectives of a BAP or CDP
Major beneficial	• Major gains in new habitats (net gains > 10 ha) of high significance for biodiversity helping to achieve relevant objectives of a BAP or CDP and underpinning government policy

10(i).3 Receiving Environment

10(i).3.1 Flora & Habitats

The proposed development was mapped according to the habitats present within the site, including those within 100m of the proposed turbine locations and proposed sub-station site in addition to habitat 25m either side of the proposed grid connection route, proposed access routes and proposed transport route upgrade.

In general the vast majority of the application site and its surrounds is comprised of a range of upland habitats including wet grassland, wet heath, upland blanket bog and lowland blanket bog. These habitats are typical of the wider area, which is characterised by upland habitats.

The proposed grid connection lies in proximity to a range of habitats including semi-improved grassland, forestry plantation, watercourses, heath and wet grassland. It is noted that the grid connection proposals will not give rise to the loss of any adjacent habitat with the proposals confined to the carriageway of the existing road/track on which the route is proposed, with the exception of a short length of grid connection between the local road to the north of the substation and the substation itself.

In addition to the proposed wind farm site and grid connection route, the proposals will involve the widening of the existing road and forestry track corridor between the wind farm and a local road approximately 4.7km to the north-east, which adjoins the R252 road further to the north. This route will also incorporate a new forestry access road, largely through an area of existing conifer plantation.

Fourteen Fossitt (2000) habitat types were identified within the study area and within the proposed site. Each of the habitats recorded during the survey are described below in respect of their species composition and relevance to the proposals and illustrated on the accompanying Figure 10(i)-1to Figure 10(i)-4. It is noted however that habitats described below, which lie within proximity to the proposed grid connection route, which will not be affected by the proposed development, are not shown on the accompanying figures.

10(i).3.1.1 Eroding/Upland Rivers (FW2)

The proposals, including several proposed turbine locations, lie in proximity to a number of minor watercourses. These are all representative of small eroding/upland rivers, with little supported aquatic vegetation and highly energetic flows.

The proposed grid connection will also pass in close proximity to the Stracashel River in several places and will cross this watercourse in one location, along the proposed grid connection route. This watercourse was again noted to support limited aquatic vegetation in the areas surveyed and is again characteristic of an eroding/upland river.

Minor watercourses within the study area are considered to be of local (higher) level importance, with the Stracashel River being considered to be of International Importance given its designation as part of the West of Ardara/Maas Road SAC.

10(i).3.1.2 Drainage Ditches (FW4)

A number of drainage ditches, within areas of blanket bog, lie in proximity to the proposed turbine locations and the proposed grid connection route. These support ephemeral flows and are likely to dry up on a yearly basis.

These features are considered to be of importance at the local (lower) level.

10(i).3.1.3 Dry-humid Acid Grassland (GS3)

Limited areas of dry-humid acid grassland are present on dry steeper sloped areas within proximity to the proposed grid connection route and in small patches on relatively rocky habitats in proximity to the proposed turbine locations. Given the small areas occupied by patches of this habitat within the proposed wind park site, this habitat has not been mapped individually as these small areas blend into areas of adjacent bog. The habitat is characterised by the presence of sheep's fescue *Festuva ovina,* mat-grass *Nardus stricta,* tormentil *Potentilla erecta,* foxglove *Digitalis purpurea* and heath bedstraw *Galium saxatile* in addition to other species more characteristic of neutral and more improved grasslands including Yorkshire fog *Holcus lanatus,* common bent *Agrostis capillaris,* creeping thistle *Cirsium arvense,* dandelion *Taraxacum officinale agg.,* white clover *Trifolium repens,* red clover *Trifolium pratense* and soft rush.

This habitat is of local (lower) level importance.

10(i).3.1.4 Semi-improved Wet Grassland (GS4)

The proposed grid connection route will lie within proximity to a number of areas of semi-improved grassland, generally grazed farmland, which is of limited species composition and of low ecological value. This habitat is also present within part of the proposed new Coillte access road. This habitat blends with areas of adjacent habitat in places including areas of scrub, dry acid grasslands and wet grasslands and is often characterised by the dominance of soft rush *Juncus effusus.*

Other species recorded within this habitat include Yorkshire fog, cock's-foot *Dactylis glomerata,* perennial rye-grass *Lolium perenne,* creeping bent *Agrostis stolonifera,* red fescue *Festuca rubra,* smooth meadow-grass *Poa pratensis,* white clover *Trifolium repens,* marsh thistle *Cirsium palustris,* creeping thistle, spear thistle *Cirsium vulgare,* broad-leaved dock *Rumex obtusifolius,* common sorrel *Rumex acetosa,* common mouse-ear *Cerastium fontanum,* creeping buttercup *Ranunculus repens* and selfheal *Prunella vulgaris.*

Wet grassland is also present within areas of upland habitat in proximity to the proposed turbine and sub-station locations. In these areas the wet grassland is more unimproved, acidic and exists in a mosaic with areas of wet heath and lowland blanket bog, with a species composition more indicative of acidic conditions associated with shallow peat.

These areas were noted to be dominated by sharp-flowered rush *Juncus acutiflorus,* soft rush and purple moor-grass *Molinia caerulea* with brown bent *Agrostis vinealis,* sweet vernal grass *Anthoxanthum odoratum,* soft rush, marsh thistle, meadow buttercup *Ranunculus acris,* creeping buttercup *Ranunculus repens,* lesser spearwort *Ranunculus flammula,* Yorkshire fog, devil's-bit scabious *Succisa pratensis,* heath bedstraw, star sedge *Carex echinata* and common knapweed *Centaurea nigra,* Wet grasslands in proximity to the proposed grid connection route, in the lower lying areas of the site, are of limited diversity and ecological interest. Areas of wet grassland in the more elevated portions of the site are generally not species rich and are typical of such habitat which is common with the locality. Wet grasslands across the site are therefore considered to be of local (lower) level importance.

10(i).3.1.5 Wet Heath (HH3)

Drier areas within the more elevated portions of the site, such as steep slopes and surrounding areas of bare rock, including within the areas proposed for turbine locations and access to proposed turbine locations, comprise areas of wet heath which exist in the margins of areas of upland and lowland blanket bog.

Species recorded within this habitat include ling, cross-leaved heath, bell heather *Erica cinerea,* purple moor-grass, bilberry *Vaccinium myrtillus,* hard fern *Blechnum spicant,* sharp-flowered rush, heath plait-moss *Hypnum jutlandicum,* tormentil, bog asphodel *Narthecium ossifragum,* common milkwort *Polygala vulgaris*, heath milkwort *Polygala serpyliifolia,* sweet vernal grass, heath dog-violet *Viola canina* and occasional red bog moss *Sphagnum capillifolium* and blunt-leaved bog moss *Sphagnum palustre*.

These areas of habitat are typical of those found widely in the locality and are therefore considered to be of local (lower) level importance.

10(i).3.1.6 Upland and Lowland Blanket Bog (PB2 & PB3)

The vast majority of the areas in which the turbines, access road and sub-station are proposed, are comprised of lowland blanket bog, with occasional areas of upland blanket bog, on varying depths of peat and varying levels of moisture. These habitats have been subject to drainage for peat cutting and agriculture in some places and exist in a mosaic with areas of adjacent wet grassland, wet heath and bare rock. Flushes and very wet hollows are supported within this habitat which support high coverage of sphagnum among other species.

Species present within this habitat include many-headed cotton-grass, ling, cross-leaved heath, bog asphodel, lousewort *Pedicularis sylvatica,* devil's-bit scabious, bog pimpernel *Anagallis tenella,* deer grass, star sedge, black bog rush *Schoenus nigricans,* sharp-flowered rush, bog violet *Viola palustris,* carnation sedge *Carex panacea* and purple moor-grass. Red bog moss, blunt-leaved bog moss, recurved sphagnum *Sphagnum recurvum* and feathery bog moss *Sphagnum cuspidatum* are widely present, with the latter being present in wetter flush areas. Other vegetation within this habitat more indicative of wet grassland habitat

While there is typically a graduation from lowland blanket bog in the lower lying areas of the site, to upland blanket bog in those areas at higher altitudes with the two habitats being difficult to differentiate in these areas, there is a clear boundary between these habitats on the slopes above the proposed T3 turbine location, which show a clear transition into upland blanket bog with ling, bilberry and *Ericoids* being dominant.

Wetter areas of these habitats support higher densities of sharp-flowered rush, purple moor-grass and many-headed cotton-grass in addition to stands of bog myrtle *Myrica gale,* bog bean *Menyanthes trifoliata*, common butterwort *Pinguicula vulgaris* and feathery bog moss.

These habitats are of relatively greater ecological value in the context of the site, however they are not of any special significance in the context of the wider locality in which such habitat is common and widespread. This habitat is therefore considered to be of ecological importance at the local (higher) level.

10(i).3.1.7 Rich Fen and Flush (PF1)

Flushes are present in areas of upland and lowland blanket bog throughout the site, particularly in plateaus and flatter areas amongst the slopes. Given the small size of these areas, the habitat has not been individually mapped however they are present as occasional throughout areas of blanket bog, as is typical for this habitat. The habitat is characterised by wet areas where water arises or collects and typically support high densities of sedges including star sedge and flea sedge *Carex pulicaris* in addition to sharp-flowered rush, purple moor-grass, many-headed cotton grass *Eriophorum angustifolium*, bog bean, bog pimpernel *Anagallis tenella* and feathery bog-moss.

This habitat is considered to be of ecological importance at the local (lower) level.

10(i).3.1.8 Conifer Plantation (WD4)

Areas of conifer plantation are situated in various locations within proximity to proposed turbine locations, in addition to the proposed grid connection route and transport route upgrade. The proposed access routes to Turbines T4-T7 and T1 will also traverse areas of existing conifer plantation. Much of this plantation was planted in the late 1990's and has not been felled in the intervening period.

A further area of forestry plantation will also be lost in order to facilitate the construction of the proposed new Coillte access road, at Quinn's Corner, approximately 4.7km to the north-east of the proposed wind farm site.

These areas are dominated by sitka spruce *Picea stichensis* or Norway spruce *Picea abies*, with few other species present. While these areas may have some value for a limited range of faunal species, including birds and bats, they are considered to be of intrinsically low ecological value and are therefore considered to be of importance at the local (lower) level.

10(i).3.1.9 Scrub (WS1)

Limited areas of scrub are present in proximity to areas of forestry plantation along the proposed turbine access routes and in proximity to the proposed grid connection route. These are comprised of relatively young stands of grey willow *Salix cinerea,* goat willow *Salix caprea* and gorse.

These habitats are small scale, in narrow bands and small stands, and as such are of limited ecological value. This habitat is therefore considered to be of importance at the local (lower) level.

10(i).3.1.10 Recently Felled Woodland (WS5)

A few small areas of recently felled forestry are present adjacent and in close proximity to the proposed grid connection route.

These areas appear to be felled sitka spruce with minor regeneration of tall ruderal species, bramble *Rubus fruticosus* and sitka spruce. This habitat is of importance at the local (lower) level.

10(i).3.1.11 Hedgerows and Treelines (WL1 & WL2)

A number of managed and unmanaged hedgerows and treelines are present as field and residential property boundaries in proximity to the proposed grid connection route, in addition to areas in proximity to the proposed turbine T4. These are comprised of a range of species and are of variable character. Typical species include grey willow, goat willow, gorse, downy birch *Betula pubescens,* holly *Ilex aquifolium,* rowan *Sorbus aucuparia,* sycamore *Acer pseudoplatanus,* ash *Fraxinus excelsior* and cypress *Cupressus leylandii.*

These features are generally in poor condition and as such are considered to be of importance at the local (lower) level.

10(i).3.1.12 Scattered Trees and Parkland (WD5)

A number of scattered trees including mature hawthorn *Crategus monogyna,* sycamore, Norway spruce and sitka spruce are present within areas of semi-improved grassland in proximity to the proposed T4 turbine location.

These features are considered to be of importance at the local (lower) level.

10(i).3.1.13 Exposed Siliceous Rock (ER1)

Areas of un-vegetated rock are scattered throughout upland habitats within the site, generally within the upland areas in which the proposed turbines and turbine access route are located. Given the small areas in which bare rock is supported this habitat has not been individually mapped, however it is present scattered throughout the proposed wind park site. These features are of low ecological value and are therefore considered to be of importance at the local (lower) level.

10(i).3.1.14 Recolonising Bare Ground (ED3)

Areas of recolonising bare ground are present in proximity to the proposed grid connection route, including areas of waste ground adjacent to the local road, in addition to the forestry track which accesses the Eirgrid substation and the local road itself.

These areas are largely bare, with some ephemeral short perennial species in addition to a limited range of species from adjacent habitats including heath and grasslands. These habitats are of low ecological value and are therefore considered to be of importance at the local (lower) level.

10(i).3.1.15 Buildings and Artificial Surfaces (BL3)

A number of buildings are present, both within the site in addition to within close proximity to the proposed grid connection route. These are of varying structure and age and are of low intrinsic ecological value.

Artificial hardstanding, including tarmac and gravel, is present along the proposed grid connection route, comprising the local road and forestry access track. This habitat is of negligible ecological value.

These habitats are considered to be of importance at the local (lower) level.

Figure 10(i) -1 Terrestrial Habitat Map (T8-T5)

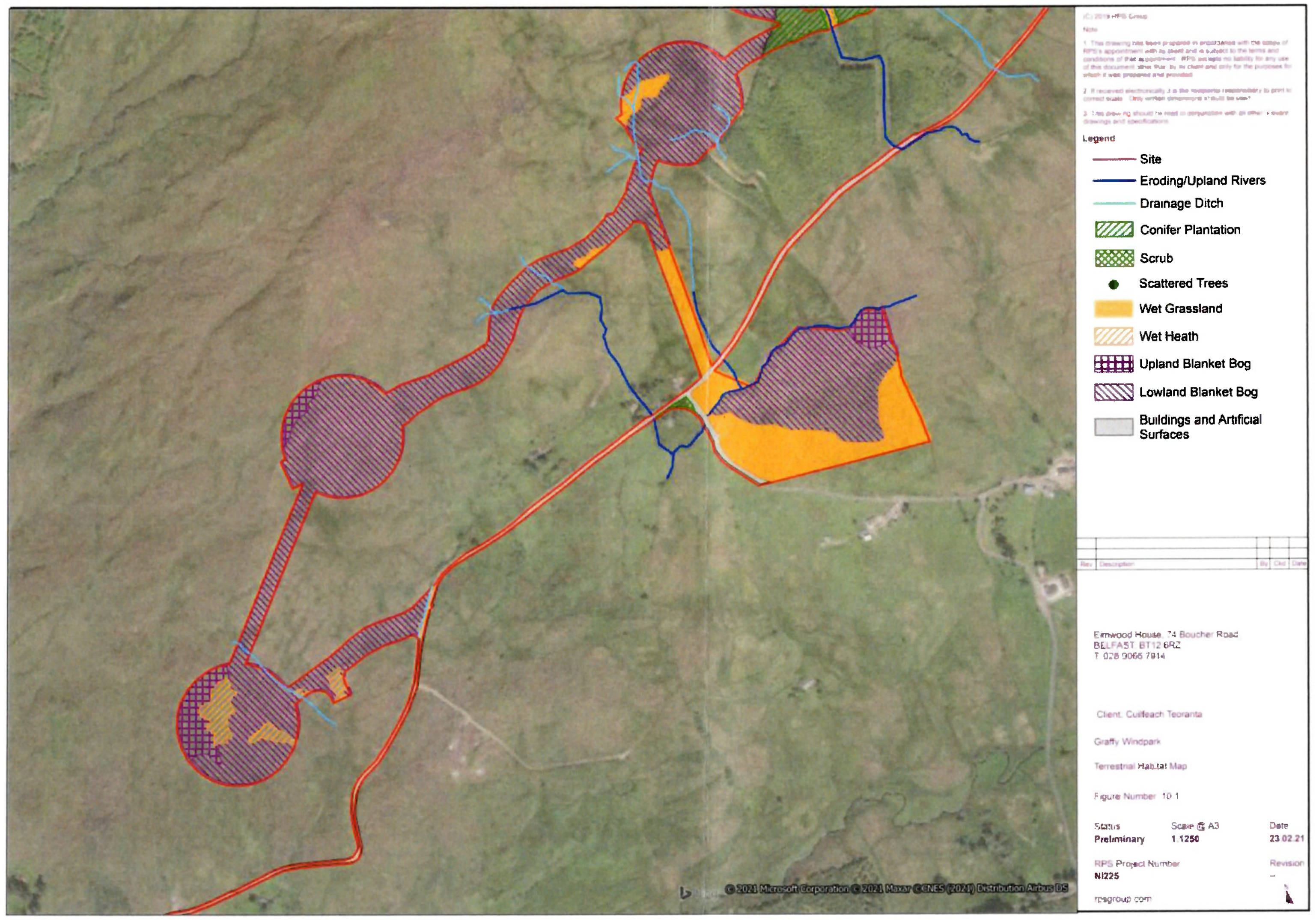
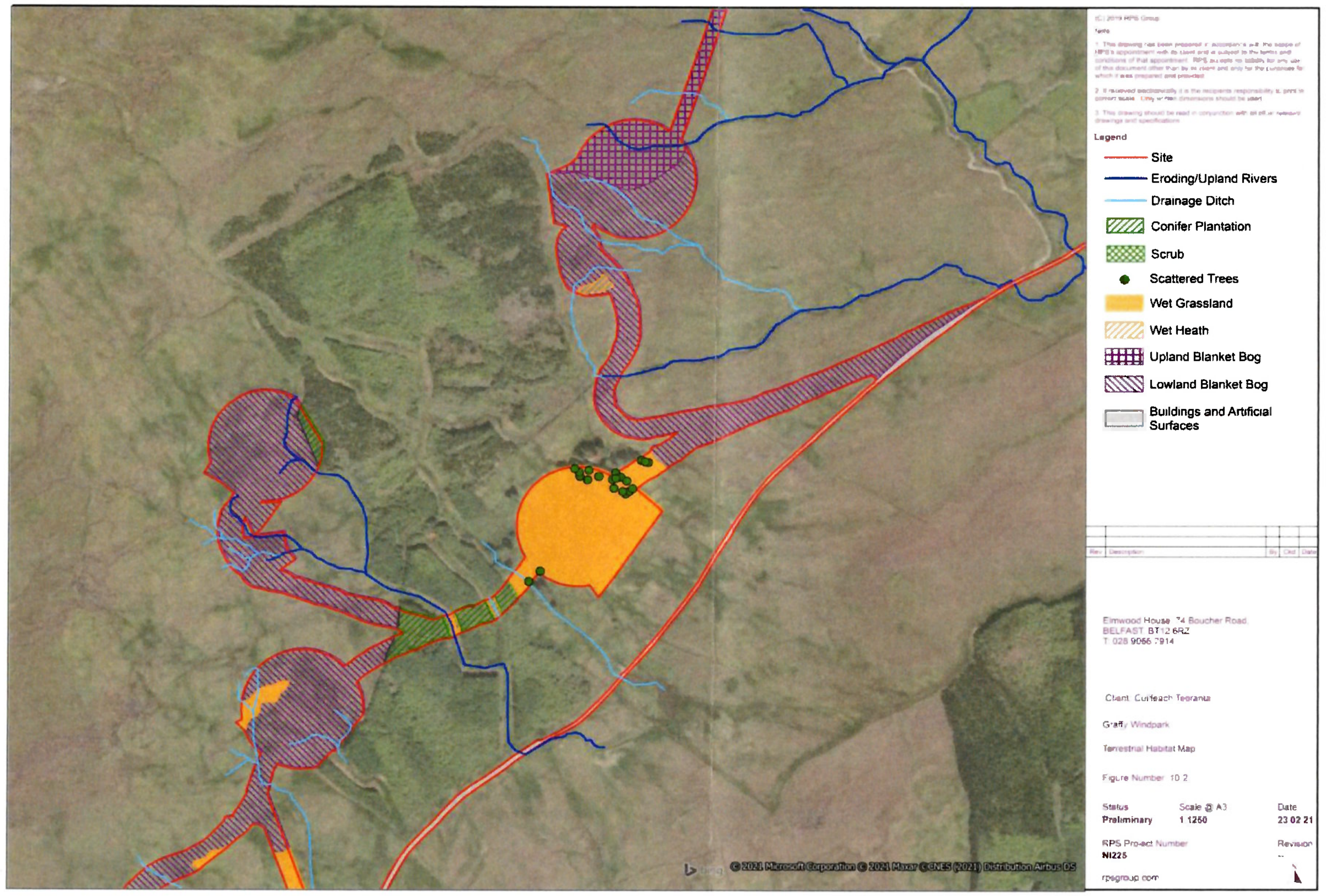


Figure 10(i) -2 Terrestrial Habitat Map (T5-T3)



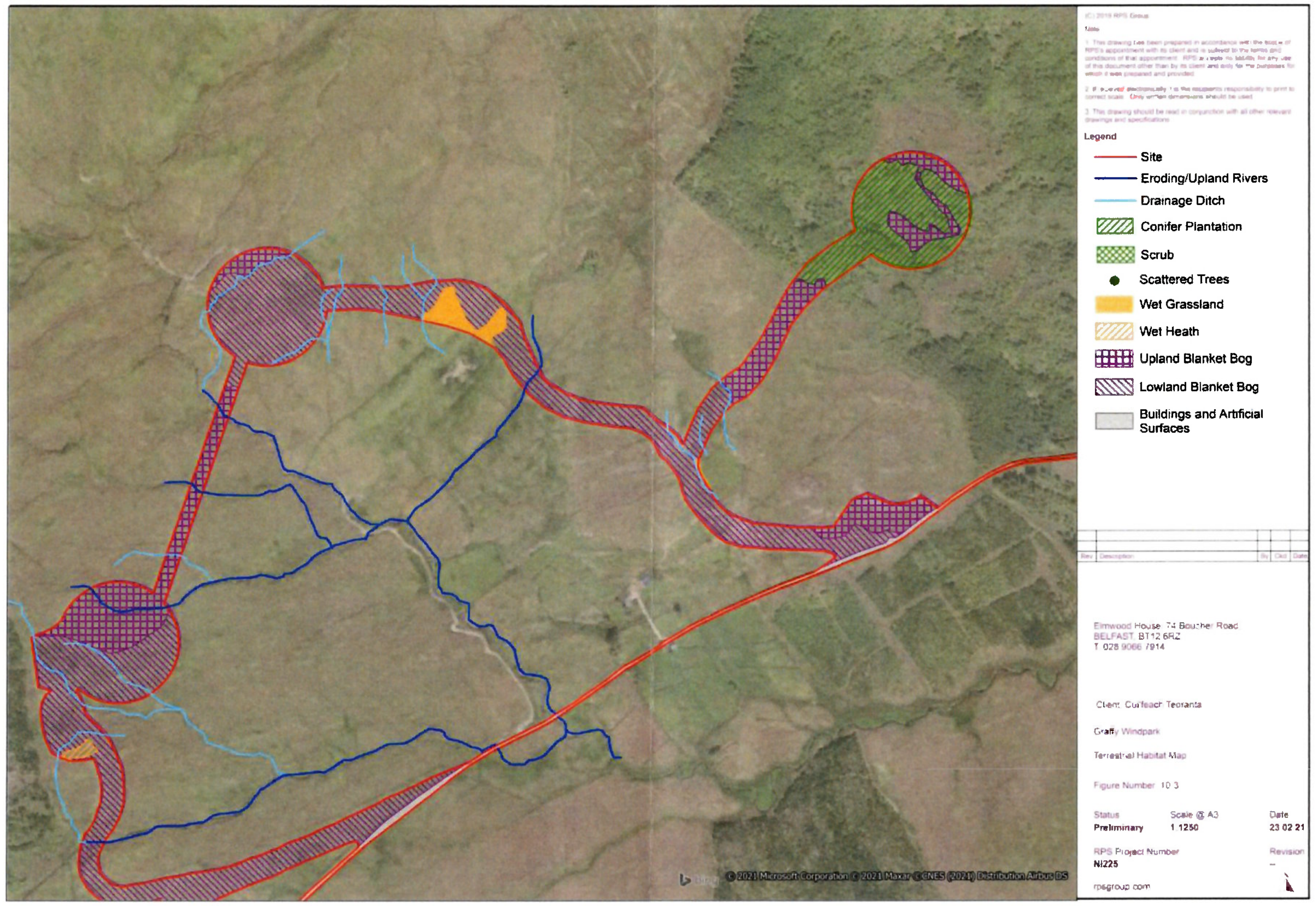


Figure 10(i) -3 Terrestrial Habitat Map (T3-T1)

Figure 10(i) - 4 Terrestrial Habitat Map (Forestry Access Road)

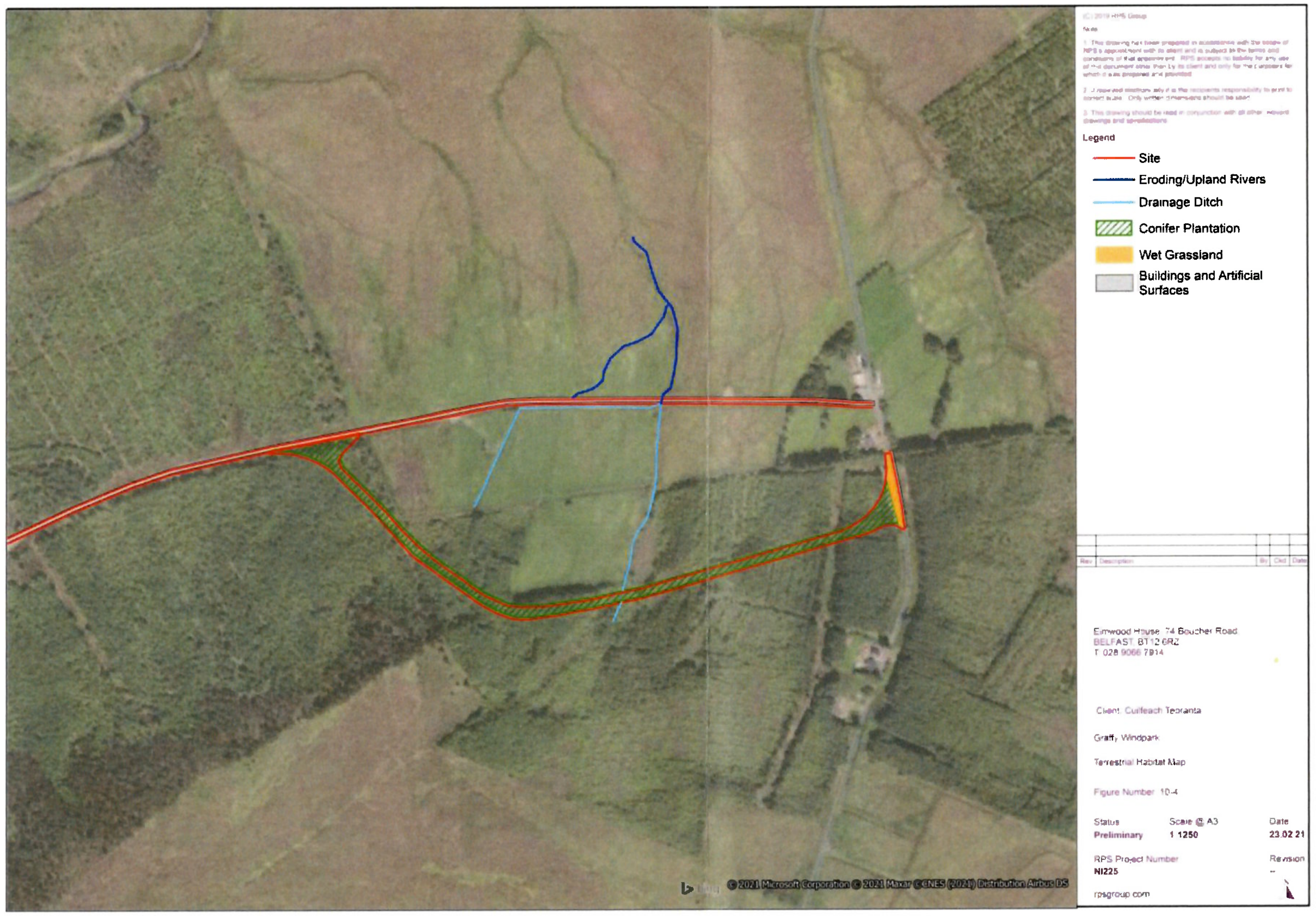


Plate 10(i) -1 Turbine Location T1

Plate 10(i) -2 Turbine Location T2

Plate 10(i) -3 Turbine Location T3

Plate 10(i) -4 Turbine Location T4

Plate 10(i) -5 Turbine Location T5

Plate 10(i) -6 Turbine Location T6

Plate 10(i) -7 Turbine Location T7

Plate 10(i) -8 Turbine Location T8

10(i).3.2 Flora Protection Order (FPO) & Rare Plants

The NBDC records search identified a single species listed under the Flora Protection Order (2015) within the 10km^2 search area. These are presented in Table 10(i)-3.

Table 10(i)-3 Floral Protection Order (2015) species within 10 km^2 of Proposed Project.

Species	Last recorded
Braided Frostwort *Gymnomitrion concinnatum*	2001

There were no Flora Protection Order (2015) species recorded across the site of the Graffy Windpark Project during the 2020 habitat surveys.

10(i).4 Terrestrial Mammals

10(i).4.1 *Badger*

The proposed wind farm site is entirely situated within an area of relatively wet uplands with limited foraging opportunities for Badger *Meles meles*. All habitats within the site, and within 25m of proposed works were searched for evidence indicating the presence of badgers or badgers setts. No such evidence or any badger setts were recorded within the search area.

The NBDC records search identified 71 records of badger from within the 10km search area. It is noted however that this search area is large and inclusive of lowland areas with greater habitat suitability than the Application Site. 17 of these records were returned from areas within 1km of the lower lying areas of proposed development and within proximity to the proposed grid connection.

During bat and bird surveys within the wider locality of the site, undertaken by Woodrow Sustainable Solutions Ltd., a single potential sett and evidence of foraging badgers and latrines were recorded. The potential sett was located over 250m from the closest aspect of the proposed works, that being the proposed grid connection route. Evidence of foraging badgers was recorded from within close proximity to the application site boundary in a number of locations, with the only recorded latrine located over 100m from the application site at its closest point.

On the basis of this information it is considered that the areas of habitat to be affected by the proposed development are of low importance for badger and therefore that the proposals have limited potential to impact upon this species, as discussed further below.

10(i).4.2 *Otter*

Otters *Lutra lutra* are widespread in Ireland, found in a variety of aquatic habitats, both freshwater and marine. The Application Site is largely comprised of semi-natural and upland terrestrial habitats. The proposals, specifically the proposed grid connection route, will cross a number of watercourses which have potential to be of importance for otter.

Where the proposed grid connection route, or any other aspect of the proposals lies in proximity to a watercourse, the watercourse was searched for a distance of 150m upstream and downstream of the proposals to check for evidence of otter activity and particularly for the presence of otter holts. No holts were recorded during the survey, furthermore no signs of otter activity were noted during the survey, it is noted however that surveys were undertaken after a period of high flow and as such spraint and other otter signs may have been previously washed away.

The NBDC records search identified 22 records of otter from within 10km of the proposed development. Two of these records were returned from within 1km of the proposed development.

During bat and bird surveys within the wider locality of the site, undertaken by Woodrow Sustainable Solutions Ltd., evidence of otter presence, namely a number of spraint locations, in addition to a number of potential holts, was recorded along the Stranagoppogue River. The potential holts were located at least 250m from the closest aspect of the proposed works, that being the proposed grid connection route, to the south.

It is considered therefore that the lengths of watercourse in proximity to the application site, are likely to be utilised by otters for foraging and migration and as such are of local level importance for this species.

10(i).4.3 *Other protected Mammal Species*

The Application Site supports a range of habitats which are suitable for and lie within the range of further protected mammal species including Irish hare *Lepus timidus hibernicus,* red deer *Cervus elaphus,* pine marten *Martes martes* and red squirrel *Sciurus vulgaris*.

The NBDC records search returned the following records for each of the species within 10km and 1km of the Application Site, shown in Table 10(i)-4.

Table 10(i)-4 NBDC Protected Mammal records from within 10km and 1km of the Proposed Development.

Species	Records within	Records within 1km
Irish hare *Lepus timidus hibernicus concinnatum*	8	1
red deer *Cervus elaphus*	27	2
pine marten *Martes martes*	7	0
red squirrel *Sciurus vulgaris*	22	3

It is noted that these species are likely to be present within the application site on at least an occasional basis and to utilise habitats which will be affected by the proposed development. None of these species were recorded within the site during survey work undertaken by RPS in 2020. During bird and bat survey work undertaken by Woodrow Sustainable Solutions Ltd. red deer and Irish hare were recorded within the general vicinity of the site.

It is considered that the relatively small areas of habitat, which will be affected by the proposed development are likely to be of relatively low ecological value for these species.

10(i).5 Invertebrates

10(i).5.1 *Marsh Fritillary*

The Application Site supports a range of habitats, including areas of wet heath with very scattered devil's-bit scabious, which offer potential opportunities for marsh fritillary *Euphydryas aurinia*. It is noted that a number of dense patches of devil's-bit scabious were present in proximity to the site of the proposed works, which were considered to offer good opportunities for this species, however no such dense patches were recorded within the footprint of the proposed scheme, with the species being relatively uncommon and scattered within these areas, furthermore no larval webs of the species were recorded within the Application Site, during surveys of these areas undertaken by RPS in September 2020.

The NBDC records search identified 67 records of marsh fritillary from within 10km of the proposed development. One of these records was returned from within 1km of the proposed development.

During bird and bat survey work undertaken by Woodrow Sustainable Solutions Ltd. adult and larval marsh fritillary were recorded within the general vicinity of, but not within, the site.

It is considered therefore that the site is likely to support the species on an occasional and transitory basis and given the lack of extensive coverage of devil's-bit scabious, habitats within the Application

Site are unlikely to be of particular significance for the species. Nevertheless a precautionary approach to site clearance works is recommended and discussed below.

10(i).6 Potential Impacts of the Graffy Windpark Project

As outlined above, the valuation and impact assessment for terrestrial biodiversity has been undertaken following the guidance and methodology set out in CIEEM (2018); EC (2017); EPA (2017); EC (2013); BSI (2013) and NRA (2009);

Table 10(i)-**1** sets out a geographic frame of reference and criteria for valuing ecological features. Table 10(i)-2 sets out criteria for predicting magnitudes of effect. These tables have been prepared with due regard to EC, CIEEM, EPA and NRA guidelines.

The predicted magnitude of potential effects on biodiversity features is based on the criteria set out in Table 10(i)-2 and determines whether or not impacts are significant in the absence of mitigation.

Significant impacts are moderate or major effects which require avoidance, reduction or counterbalancing measures to mitigate or offset their adverse effects. Beneficial effects do not require mitigation measures as their effects are welcomed.

10(i).7 Potential Effects at Construction Phase

Habitats

The following vegetated features will be affected by the development:

- **Eroding/Upland Rivers**: The proposed development will require the construction of a number of watercourse crossings including bridges or culverts to facilitate construction of turbine access roads. In addition excavations at watercourse crossings will be required in order to facilitate installation of the proposed grid connection. As such there is potential for temporary minor disturbance to these features at construction phase. This includes potential alteration to the banks of these watercourses, cutting and levelling in proximity to these watercourses and associated potential for sedimentation or pollution of these watercourses throughout construction. These potential impacts are addressed within Chapter 6: Surface Water & Hydrology.
- **Upland Habitat Complex**: This complex including areas of acid grassland, wet grassland, wet heath, upland and lowland blanket bog, bare rock and flushes, described individually above, will be subject to losses through land take in order to facilitate the construction of the turbine locations, proposed access road to each turbine location and the proposed sub-station site.

- **Conifer Plantation**: Areas of conifer plantation in addition to minor areas of associated scrub will be lost in order to facilitate the construction of proposed access roads to the turbine locations, the proposed new forestry access road, in addition to cleared buffer areas around the turbine locations to mitigate for potential impacts upon foraging and commuting bats (see Section 10 (iii)).

Losses to these habitats are set out by approximate area below within Table 10(i)-5, it is noted that these figures, on a precautionary basis include for all areas of the habitat within the Application Site boundary however in reality a significant proportion of these areas will not be affected by the proposals or will only be affected temporarily. No significant indirect effects upon habitats within the site or beyond are predicted as a result of the proposed development.

Table 10(i)-5 Habitats Losses associated with the proposed Development

Habitat	Approximate Area to be lost within the Proposals (km^2)
Acid Grassland	<0.001
Wet Grassland	0.03
Wet Heath	0.005
Upland and Lowland Blanket Bog	0.277
Flush	<0.001
Conifer Plantation	0.05

The majority of these habitats are of local (lower) value. In accordance with Table 10(i)-2, permanent loss of these features is predicted to result in a minor adverse magnitude of effect, and their loss will not result in any significant environmental impact. In accordance with the methodology set out in Section 10(i).1, these impacts do not require avoidance, reduction or counterbalancing measures to be implemented.

Areas of lowland and upland blanket bog within the site are considered to be of local (higher) level importance and are of relatively greater ecological value within the context of the site. These areas will be subject to relatively minor losses totalling some $0.277km^2$, such an effect is considered to be **Significant (Moderate Adverse)** in the absence of mitigation.

Protected Flora

No species listed on the Floral Protection Order (2015) were recorded within the Application Site. There are consequently no potential impacts, significant or otherwise on protected floral species as a result of the construction or operation of the Graffy Windpark Project.

Protected Fauna

It has been established that a number of terrestrial protected species, with the exception of those discussed within Sections 10(ii) and 10(iii), are likely to be present within the Application Site on at least an occasional basis. Potential impacts upon these species are discussed individually below.

- **Badger**: The proposed development will not give rise to the loss of any badger setts. The vast majority of habitats to be lost as a result of the proposed development, offer sub-optimal foraging opportunities for the species. On this basis it is considered that impacts to the species resulting from the proposed development will be negligible.
- **Otter**: The proposed development will not require construction works within 150m of any known potential otter holt. Construction activities in proximity to larger watercourses will be limited to minor short-term works associated with the installation of the grid connection route. A number of minor watercourses and drainage channels will be subject to alteration in order to facilitate the construction of proposed access roads. It is considered that given the nature of these works there will be no potential for significant adverse impacts to otter arising through aerial noise or visual disturbance.
- The proposed development at construction stage has potential to give rise to the release of sediments and pollutants into the freshwater environment. Such releases could give rise to an adverse effect upon the freshwater environment with potential impacts to otter including temporary decrease in prey abundance and environmental toxicity. The potential for such impacts to arise is discussed further within Section 10 (iv) of the biodiversity chapter, which covers impacts upon aquatic ecology. Such impacts in the absence of mitigation are considered likely to be minor adverse.
- **Other Protected Mammals**: Given the nature of the proposed development and the relatively small scale of habitat losses required, it is considered that the proposals would have potential to give rise to only minor small scale and temporary disturbance to other protected mammals which are likely to utilise habitats within the site on an occasional basis. Predicted impacts are therefore considered to be negligible.
- **Marsh Fritillary**: The Application Site supports habitat which is marginally suitable for marsh fritillary with scattered devil's-bit scabious present throughout areas of the site, however no areas which support dense patches of the plant are to be lost as a result of the proposed development and in general habitat for the species within the site is considered to be largely

unsuitable. The proposals are therefore considered to have some limited potential to give rise to the killing of marsh fritillary larvae at the construction stage in the absence of mitigation. Such an effect is considered to be major adverse.

- Loss of small areas of suitable but sub-optimal habitat for this species within the site are considered unlikely to give rise to a decrease in the local conservation status of the species, due to the abundance of similar habitats in the wider locality.

10(i).8 Potential Effects at Operational Phase

Habitats

The operational phase of the proposed development will not have potential to give rise to any impacts to the supported habitats within the Application Site.

Protected Fauna

The proposed development at the operational phase does not have potential to give rise to any significant effects upon terrestrial protected species, with the exception of those discussed within Sections 10 (ii) and 10 (iii) of the biodiversity chapter.

10(i).9 Potential Cumulative Effects

The proposed wind farm is spread across two river catchments. There are no developments, existing or proposed, in the vicinity of the site that would result in cumulative impacts.

10(i).10 Mitigation and monitoring measures

As outlined in Section 10(i).1.3, significant impacts are described as effects which require avoidance, reduction or counterbalancing measures to mitigate or offset their adverse effects.

It is considered that the proposed development will give rise to a single significant effect, in respect of ecology, that being the loss of areas of lowland and upland raised bog required in order to facilitate construction of the proposed project at construction phase, in the absence of mitigation.

Losses to these habitats required in order to facilitate the proposed construction will be relatively limited in the context of the wider locality, in which large areas of these habitats are supported, with a maximum total of 45,158 m^3 of peat to be generated through excavation during construction. As set out within Chapter 6: Soils, Geology and Hydrogeology, this excavated peat will be utilised to restore the landscape around the proposed turbine locations, substation location and turbine access road, furthermore any excess peat will be taken to proposed peat regeneration areas.

Peat regeneration areas will be located at the entrance to the proposed access to turbines T1 and T2 and in areas of semi-improved grassland in proximity to turbine T4. Regeneration areas will be supported by rock and earthen berms, to allow for peat placement up to, but not exceeding, 1.2m in depth. The upper layer of peat excavated will be placed on top of the regeneration areas to allow for swift revegetation of these areas. Further details on this methodology and the quantities of excavated peat to be utilised for the various parts of the post construction are included at Chapter 6 of this EIAR.

Post construction monitoring of areas in which peat is to be reused within the scheme will be undertaken by a suitably qualified Ecological Clerk of Works (ECoW) to ensure that vegetation becomes established. This monitoring will identify the requirement for any remedial measures.

It is considered that these measures for peat recovery and reuse within the scheme, will fully mitigate for predicted significant effects arising through the loss of areas of areas of blanket bog required in order to facilitate the proposed construction.

There are no further effects predicted in this assessment of terrestrial habitats to be affected by the proposed development. Thus, there are no further potential significant impacts arising which require avoidance, reduction or counterbalancing measures to mitigate or offset their adverse effects.

The proposed development has potential to give rise to minor adverse effects upon otter, as a result of potential sedimentation and pollution of the freshwater environment. Mitigation in respect of the aquatic environment is detailed within Chapter 6 Soils, Geology and Hydrogeology and Section 10(iv) -aquatic ecology- of the Biodiversity chapter and subject to the implementation of these measures it is envisaged that potential impacts upon otter will be fully mitigated.

The proposed development has potential to give rise to major adverse effects upon marsh fritillary, through the killing of larval individuals, which may be present within small areas of marginally suitable habitat to be lost as a result of the proposed development, however no marsh fritillary or dense areas of devil's-bit scabious were recorded within the Application Site.

Therefore, on a precautionary basis, an ECoW will be appointed for the duration of the construction works. The ECoW will undertake pre-construction surveys of the areas of habitat to be subject to subsequent clearance to establish the presence or absence of larval or adult marsh fritillary or any unrecorded dense patches of devil's-bit scabious within the site which may provide optimal opportunities for the species.

Should any previously unrecorded dense patches of devil's-bit scabious be recorded within the scheme footprint these will be subject to careful inspection for eggs, larvae or pupa of the marsh fritillary.

Should marsh fritillary be recorded during these surveys, works will cease in these areas, fencing installed around the suitable habitats used by the species and appropriate mitigation will be agreed with NPWS in association with a license application for the proposed works.

Appropriate mitigation in such a scenario would include the appropriate timing of habitat clearance works to align with translocation of the caterpillars within the period between late- July and September or habitat clearance works within the flying adult period late-May to July. It is noted however that on the basis of the findings of previously undertaken surveys the probability of such a scenario arising is considered to be very low.

10(i).11 Residual Effects

Flora & Habitats

There are no significant residual impacts predicted on terrestrial flora and habitat features as a result of the construction and operation of the proposed Graffy Windpark Project.

Protected Species

There are no significant residual impacts predicted on terrestrial protected species, discussed above, as a result of the construction and operation of the proposed Graffy Windpark Project.

10(i).12 Designated areas

10(i).12.1 Receiving Environment

The proposed development site lies in proximity, or is hydrologically connected to a number of designated sites of nature conservation interest, within the locality and further afield.

A total of 13 European Sites, in addition to a further 17 nationally designated sites, are considered to be within the Zone of Influence of the proposed project. The location of these sites is presented in **Error! Reference source not found.** and 10(i)-6. Details of these sites, including Qualifying Interests/Special Conservation Interests and distance from the Application Site are found in **Error! Reference source not found.**6. The information contained in these tables is based on publicly available data, sourced from NPWS in September 2020.

The likely effects of the proposed development upon European sites are considered within in the Habitats Directive appraisals containing a screening appraisal and a Natura Impact Statement submitted under separate cover with the application for development consent. These sites, in addition to potential effects on other designated sites, are also considered in this section of the EIAR.

The Graffy Windpark Project has been assessed for its potential to affect designated sites, for which a pathway of effect can be reasonably established between a receptor and the source of effect.

Table 10(i)-6 Designated Sites within the ZoI of the Proposed Project

Site Name / Code	Distance (Km) / Direction from site	Features of Conservation Interest
River Finn SAC [SAC 002301]	N/A (Underlies the site boundary between the access to turbines T1 and T2 and T3; and is hydrologically linked to the proposed new forestry road) South-East	[3110] Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae) [4010] Northern Atlantic wet heaths with Erica tetralix [7130] Blanket bogs (if active bog) [7140] Transition mires and quaking bogs [1106] Salmon *Salmo salar* [1355] Otter *Lutra lutra*
West of Ardara/Maas Road SAC and pNHA [002301]	N/A (the proposed grid connection route will span the SAC) Hydrological connections are supported between the proposed wind farm and the SAC via tributaries. South and West	[1130] Estuaries [1140] Mudflats and sandflats not covered by seawater at Low tide [1160] Large shallow inlets and bays [1210] Annual vegetation of drift lines [1330] Atlantic salt meadows (*Glauco-Puccinellietalia Maritimae*) [1410] Mediterranean salt meadows (*Juncetalia maritime*) [2110] Embryonic shifting dunes [2120] Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2130] Fixed coastal dunes with herbaceous vegetation (grey dunes)

[2140] Decalcified fixed dunes with *Empetrum nigrum*

[2150] Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)

[2170] Dunes with Salix repens ssp. argentea (*Saliciion arenariae*)

[2190] Humid dune slacks

[21A0] Machairs (in Ireland)

[3110] Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)

[3130] Oligotrphic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoeto-Nanojuncetea*

[4010] Northern Atlantic wet heaths with *Erica tetralix*

[4030] European dry heaths

[4060] Alpine and Boreal heaths

[5130] Juniperus communis formations on heaths or calcareous grasslands

[6210] Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (Important orchid sites)

[6410] Molinia meadows on calcareous, peaty or clayey-silt laden soils (*Molinion caeruleae*)

[6510] Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)

[7130] Blanket bogs (if active bog)

[7150] Depressions on peat substrates of the *Rhynchosporion*

[7230] Alkaline fens

[1013] Geyer's whorl snail *Vertigo geyeri*

[1029] Freshwater pearl mussel *Margaritifera margaritifera*

[1065] Marsh Fritillary *Euphydryas aurinia*

		[1106] Salmon *Salmo salar* [1355] Otter *Lutra lutra* [1365] [Harbour seal *Phoca vitulina* [1395] Petalwort *Petalophyllum ralfsii* [1833] Slender Naiad *Najas flexilis*
Lough Nilllan Bog (Carrickatlieve) SAC and pNHA [000165]	1.7km South	[3110] Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) [7130] Blanket bogs (if active bog)
Lough Nillan Bog SPA [004110]	1.7km South	[A098] Merlin *Falco columbarius* [A140] Golden Plover *Pluvialis apricaria* [A395] Greenland white-fronted goose *Anser albifrons flavirostris* [A466] Dunlin *Calidris alpina schinzii*
Lough Finn pNHA [001163]	1.9km North	Wetlands
Derryveagh and Glendowan Mountains SPA [004039]	2.4km North	[A001] Red-throated diver *Gavia stellata* [A098] Merlin *Falco columbarius* [A103] Peregrine *Falco peregrinus* [A140] Golden Plover *Pluvialis apricaria* [A466] Dunlin *Calidris alpina schinzii*
Meenmore West Bog NHA [002453]	4.1km North	Peatlands [4]
Meenaguse Scragh SAC and pNHA [001880]	4.1km South	[4010] Northern Atlantic wet heaths with *Erica tetralix*
Derkmore Wood Nature Reserve pNHA [000131]	4.5km North-West	Oak scrub with bryophytes
Cloghernagore Bog and Glenveagh National Park SAC and pNHA	4.9km North	[3110] Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) [3260] Water courses of plain to montane levels with

[002047]		The *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [4010] Northern Atlantic wet heaths with *Erica tetralix* [4030] European dry heaths [4060] Alpine and Boreal heaths [6410] Molinia meadows on calcareous, peaty or clayey-silt laden soils (*Molinion caeruleae*) [7130] Blanket bogs (if active bog) [7150] Depressions on peat substrates of the *Rhynchosporion* [91A0] Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [1029] Freshwater pearl mussel *Margaritifera margaritifera* [1106] Salmon *Salmo salar* [1355] Otter *Lutra lutra* [1421] Killarney Fern *Trichomanes speciosum*
Meentygrannagh Bog SAC and pNHA [000173]	6.1km North-East	[7130] Blanket bogs (if active bog) [7140] Transition mires and quaking bogs [7230] Alkaline fens [6216] Slender green feather-moss *Hamatocaulis vernicosus*
Coolvoy Bog SAC and pNHA [001107]	6.4km North	[7130] Blanket bogs (if active bog)
Meenaguse/Ardbane Bog SAC and pNHA [000172]	6.8km South	[7130] Blanket bogs (if active bog)
Gannivegil Bog SAC and pNHA [000142]	7.9km North-West	[3110] Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) [4010] Northern Atlantic wet heaths with *Erica tetralix*

		[7130] Blanket bogs (if active bog)
Owendoo and Cloghervaddy Bogs pNHA [002046]	8.1km South-East	Peatlands
Galwolie Bog pNHA [001132]	8.4km North-East	Peatlands
Tullytresna Bog pNHA [001870]	9.3km North-East	Peatlands
Meenybraddan Bog pNHA [001177]	11.5km South	Peatlands
Lough Eske and Ardnamona Wood SAC and pNHA [000163]	11.6km South	[3110] Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) [7220] Petrifying springs with tufa formation (*Cratoneurion*) [91A0] Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [1029] Freshwater pearl mussel *Margaritifera margaritifera* [1106] Salmon *Salmo salar* [1421] Killarney Fern *Trichomanes speciosum*
Slieve Tooey/Tormore Island/ Loughros Beg Bay SAC & pNHA [000190]	13.1km South-West	[1230] Vegetated sea cliffs of the Atlantic and Baltic coasts [2110] Embryonic shifting dunes [2120] Shifting dunes along the shoreline with Ammophila arenaria (white dunes) [2130] Fixed coastal dunes with herbaceous vegetation (grey dunes) [2140] Decalcified fixed dunes with *Empetrum nigrum* [2150] Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)

		[4060] Alpine and Boreal heaths] [7130] Blanket bogs (if active bog) [1014] Narrow-mouthed Whorl Snail *Vertigo angustior* [1355] Otter *Lutra lutra* [1364] Grey Seal *Halichoerus grypus*
Sheskinmore Lough SPA [004090]	13.2km West	[A395] Greenland white-fronted goose *Anser albifrons flavirostris*
Inishkeel SPA [004116]	14.0km West	[A045] Barnacle goose *Branta leucopsis*
Cashelnavean Bog NHA [000122]	14.2km South-East	Peatlands [4]
River Foyle and Tributaries SAC [UK0030320]	44.8km North-East	[3260] Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [1106] Salmon *Salmo salar* [1355] Otter *Lutra lutra*

Figure 10(i)-5 Designated Sites within the zone of influence of the Proposed Development

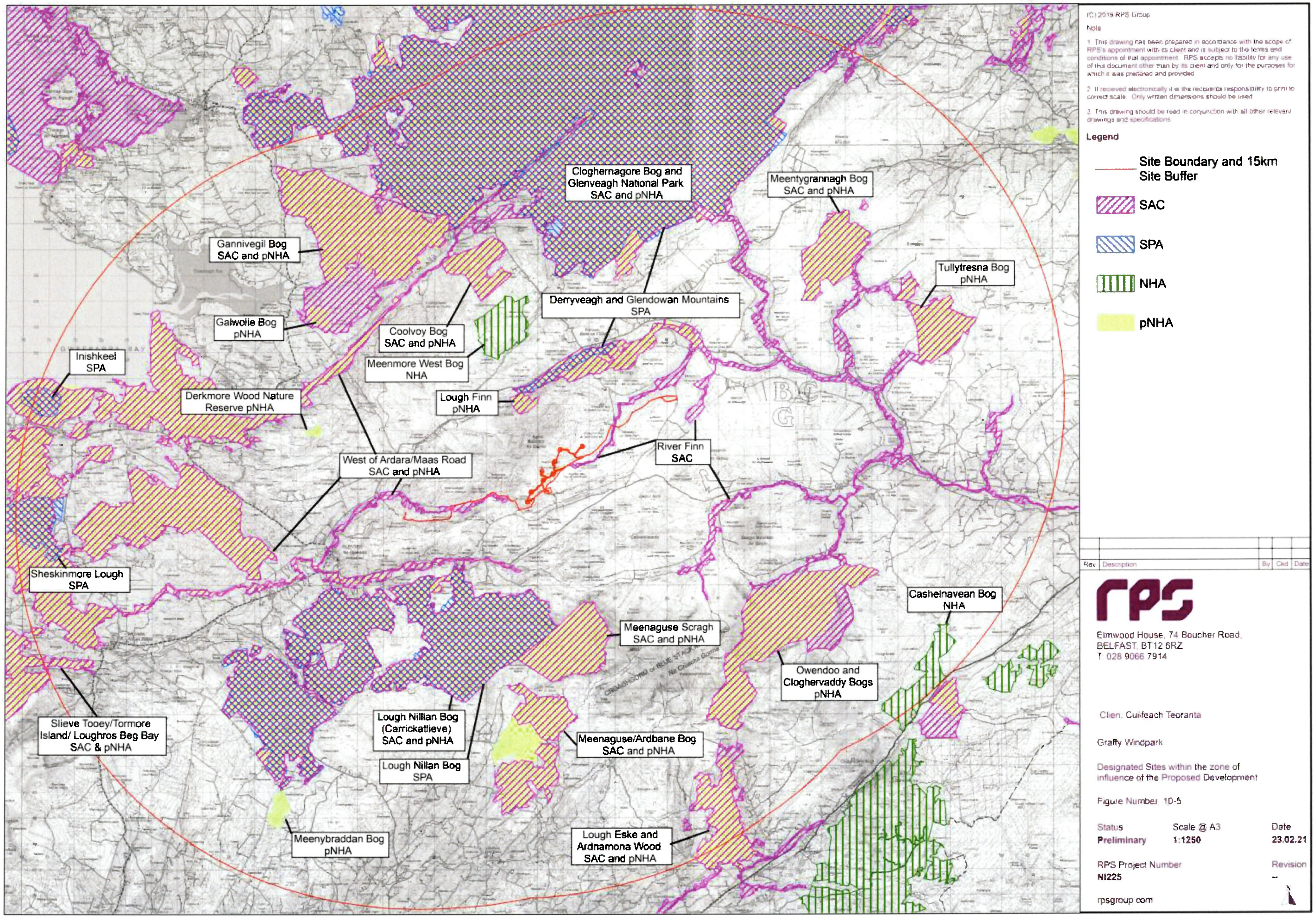
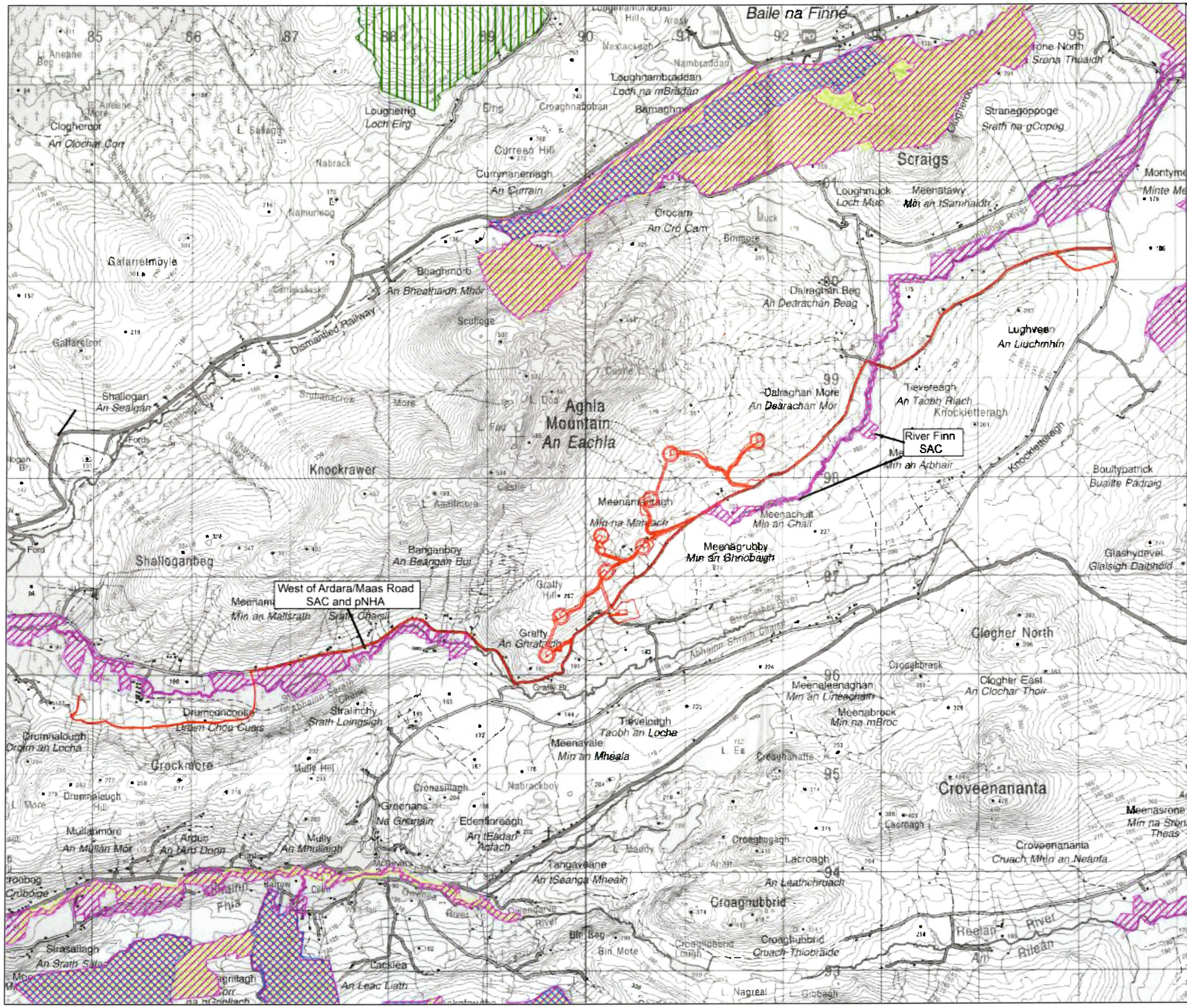


Figure 10(i)-6 Designated Sites in proximity to the Proposed Development



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Note

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Legend

- Site Boundary
- SAC
- SPA
- NHA
- pNHA

Rev	Description	By	Ckd	Date

Elmwood House, 74 Boucher Road,
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T: 028 9066 7914

Client: Cuilfeach Teoranta

Graffy Windpark

Designated Sites win proximity to the Proposed Development

Figure Number 10-6

Status	Scale @ A3	Date
Preliminary	1:1250	23.02.21

RPS Project Number
NI225

Revision
-

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10(i).12.2 Proposed Natural Heritage Areas

Natural Heritage Areas (NHAs) are designated under the Wildlife Acts as they are considered important habitats which support animals or vegetation of importance. There are no NHAs within 1km of the Proposed Project. However there is a single proposed Natural Heritage Area (pNHAs), namely West of Ardara/Maas Road pNHA, which could potentially be affected by the construction or operation of the Proposed Project. This pNHA was published on a non-statutory basis in 1995, but has not since been statutorily proposed or designated. The pNHAs are subject to limited statutory protection, but are recognised for their ecological value by planning and licensing authorities.

West of Ardara/Maas Road pNHA overlaps the West of Ardara/Maas Road SAC, discussed below, and as such conservation interests of this site and any potential impacts are considered to be fully assessed in respect of this SAC.

It is not considered that the proposed development has potential to give rise to any significant ecological effects in respect of NHAs or pNHAs which are spatially separated from and not hydrologically connected to the Application Site.

10(i).12.3 Special Areas of Conservation

Special Areas of Conservation (SACs) are designated for habitats, plants, and non-bird species, under the Habitats Directive (92/43/EEC). Two SACs are located within 1km of the proposed development namely the West of Ardara/Maas Road SAC and the River Finn SAC. These sites are situated adjacent to the proposed grid connection route, with further works being undertaken within sub-catchments feeding into watercourses which form a part of these SACs.

The River Finn SAC also lies upstream of and hydrologically connected to the River Foyle and Tributaries SAC, as such the proposals are also hydrologically linked to this SAC.

Further SACs, which are spatially separated from the proposed development and not hydrologically linked to the Application Site are not considered to be subject to any potential likely significant effects arising as a result of the proposals.

10(i).12.4 Special Protection Areas

Special Protection Areas (SPAs) are designated for bird species and their habitats, under the Birds Directive (79/409/ECC as codified by Directive 2009/147/EC). No SPAs are located within 1km of the proposed development, however two sites are located within 15km of the proposed development namely the Derryveagh and Glendowan Mountains SPA and Lough Nilan Bog SPA.

The potential for the proposed development to impact upon bird populations associated with these SPAs is discussed within Section 10(ii) of the Biodiversity chapter and within the Habitats Directive Appraisals in the NIS, which accompany the EIAR.

10(i).13 Likelihood of Impacts

Potential impacts upon SACs and pNHAs arising as a result of the proposed development are largely limited to those associated with construction stage works which will take place within the catchments of these sites and as such may give rise to hydrological effects in addition to minor temporary disturbance to qualifying species, where sites lie in close proximity to the proposed works, as discussed below.

10(i)13.1 Water Quality and Habitat Deterioration

The proposed development site lies adjacent and hydrologically connected to a number of designated sites, namely the West of Ardara/Maas Road SAC and pNHA, River Finn SAC and the River Foyle and Tributaries SAC. These SACs are designated in part, on account of the supported populations of freshwater species and habitats which are sensitive to impacts associated with water quality and habitat deterioration.

In the case of West of Ardara/Maas Road SAC and pNHA freshwater qualifying interests which are sensitive to water quality and habitat deterioration effects include freshwater pearl mussel, salmon and otter. Further qualifying interests include a number of terrestrial and coastal habitats and species, which are either not hydrologically linked to the proposals, or are coastal habitats, which lie downstream of the proposed development, but are located at a distance of at least 21.1km downstream of the site and at a point at which flows of around 92.5m^3/s arise from a catchment of some 126km^2. Over such a distance and in the context of such supported flows originating across the large catchment, any potential water quality and habitat deterioration effects are likely to be undetectable at the point at which they interact with these coastal habitats which form qualifying interests for the SAC, such as estuaries, mudflats and sandflats and saltmarsh habitats.

In the case of the River Finn SAC freshwater qualifying interests, which are sensitive to water quality and habitat deterioration effects include salmon and otter. Further qualifying interests include a number of terrestrial habitats in addition to Oligotrophic waters, which are not hydrologically linked to the proposed development as these features are not freshwater habitats, or do not lie downstream of the site.

In the case of the River Foyle and Tributaries SAC freshwater qualifying interests, which are sensitive to water quality and habitat deterioration effects, include salmon, otter and the freshwater habitat watercourses of plain to montane levels with the Ranunculion fluitantis Callitricho-Batrachion vegetation.

The proposed development will involve significant works with potential to give rise to release of materials into the hydrological environment throughout the construction stage.

Such works include:

- Excavations to facilitate installation of turbines in 8 no. locations;
- Provision of hardstanding including turbine foundations, access roads and proposed sub-station;
- Construction of proposed sub-station;
- Excavations to facilitate delivery of the proposed grid connection; and
- Movement of construction vehicles and plant throughout the proposed development site.
- Temporary construction site compound proposed adjacent to the proposed sub-station.

These works which will take place within areas which lie in proximity to minor watercourses which feed into the Stracashel River or the Stranagoppogue River, or will ultimately drain into SAC watercourses, via hydrological pathways of various lengths.

These works will give rise to the potential for likely significant effects through:

- Accidental release of highly alkaline contaminants from concrete and cement during the construction of hardstanding and other structures;
- General water quality impacts associated with works machinery, infrastructure and on-land operations including the temporary storage of construction materials, oils, fuels and chemicals; and
- Sedimentation through release of sediments, soils and other materials from proposed excavation works and vehicular movements within the site into the freshwater environment.

It is therefore considered that in the absence of mitigation measures the proposals will give rise to likely significant effects in respect of potential water quality and habitat deterioration effects upon the

West of Ardara/Maas Road SAC and pNHA, River Finn SAC and (on a precautionary basis) the River Foyle and Tributaries SAC, at construction stage, in the absence of mitigation measures.

It is considered that there is no potential for operational phase water quality and habitat deterioration effects associated with the proposed development. This conclusion is drawn on account of the nature of the proposals, which will involve minimal site works throughout operation all of which will take place within areas of hardstanding established during the construction stage.

These potential effects are discussed further within Sections 10(iv) and 10(v) of the Biodiversity chapter in respect of the aquatic environment and freshwater pearl mussel respectively.

10(i).13.2 Aerial Noise and Visual Disturbance

The proposed development will give rise to significant aerial noise and visual disturbance during the construction phase, through the movement of vehicles plant and staff throughout the Application Site.

Designated sites including West of Ardara/Maas Road SAC and pNHA and the River Finn SAC, lie adjacent to the Application Site. These sites support a single common qualifying interest, otter, which may be vulnerable to aerial noise and visual disturbance as a result of the proposed development.

It is noted that the conservation objectives for these sites (NPWS 2015 and 2017) illustrate the known commuting areas of the species within the SACs. Both of these distribution maps do not show otter commuting areas within the Stranagoppogue River or the Stracashel River, or within proximity to the proposed development. It is considered likely however that these areas of watercourse are utilised by otter while not representing areas of core habitat for the distribution of this species within the SACs. The extended habitat survey of the proposed development site, undertaken by RPS in 2020 did not record the presence of any potential otter holts within 150m of any part of the proposed development. Proposed works in close proximity to the relevant watercourses will be limited to the installation of the proposed grid connection, any resultant disturbance therefore will be of extremely limited scale and duration. On this basis it is considered that the proposed development would have no potential to give rise to a significant aerial noise and visual disturbance effect upon the West of Ardara/Maas Road SAC and pNHA and the River Finn SAC.

10(i).14 Remedial and Mitigation Measures

Mitigation measures to avoid pollution and sedimentation at construction and operational stages derive from Chapter 6 Soils, Geology and Hydrology of the EIAR, in addition to those discussed within other sections of the Biodiversity Chapter 10, namely aquatic ecology 10(iv) and freshwater pearl mussel 10(v).

10(i).15 Residual Impacts

No further or additional likely significant effects were predicted upon any proposed NHA site or SAC.

As a result there is no residual impacts predicted upon any NHA, pNHA or SAC as a result of the construction and operation of the Graffy Windpark project.

10(i).16 Transboundary Effects

Part of the study area associated with the proposed development is within the Upper Foyle Catchment. The Foyle catchment is a cross border catchment and therefore the hydrological link extends to areas beyond the international border in the River Foyle and Lough Foyle. The project is hydrologically linked to both the Foyle and Tributaries SAC and the Lough Foyle SPA in the Republic of Ireland. However the residual impact after the implementation of the mitigation measures is assessed as negligible and therefore there will be no potential for significant transboundary effects on water quality as a result of the Proposed Development particularly given the distance from the development site to these features.

10(i).17 Conclusion

This section of the Biodiversity Chapter of the EIAR identifies, describes and assesses in an appropriate manner, the direct and indirect significant effects of the proposed development on terrestrial biodiversity. It contains a description of the terrestrial biodiversity features and designated sites within and surrounding the site of proposed development, followed by an assessment of the potential and likely significant effects of the proposed development alone and cumulatively with other consented projects on terrestrial biodiversity features and designated sites.

The assessment of *terrestrial biodiversity* features concludes that there are no significant environmental impacts predicted upon terrestrial biodiversity features as a result of the construction, operation or decommissioning of the proposed Graffy Windpark project subject to the application of a number of mitigation measures including the appointment of an ECoW and where necessary appropriate timing of works, in addition to measures designed to prevent adverse effects upon nearby watercourses.

The assessment of designated sites concludes that potential environmental effects are predicted upon water quality and habitats within the West of Ardara/ Maas Road SAC and pNHA, River Finn SAC and on a precautionary basis the River Foyle and Tributaries SAC. Mitigation has been proposed where necessary and there is no significant residual environmental effect upon these designated sites with effective implementation of the proposed mitigation measures. Potential impacts upon bird populations associated with nearby SPAs is detailed within Section 10(ii) of the Biodiversity Chapter.

10(i).18 Natura Impact Statement

A Natura Impact Statement (NIS) has been prepared on behalf of Cuilfeach Teoranta in respect of the application for development consent in relation to the Graffy Windpark Project to document Habitats Directive stage 1 and stage 2 appraisals in relation to European sites. The NIS has been submitted under separate cover so as to enable the competent authorities to carry out the assessments required under the Habitats Directive and Irish law distinct from the assessment required under the EIA Directive.

10(ii) Avi-fauna

Chapter 10: Biodiversity
Section ii: Avi-fauna

Contents – Chapter 10: Biodiversity – Section ii: Avi-fauna

List of Tables

STATEMENT OF AUTHORITY

Mike Trewby (Senior Ecologist), assisted by Rachael O'Dwyer (Graduate Ecologist) from Woodrow Sustainable Solution Ltd (Woodrow) were responsible for compiling the Avi-fauna Section for the ES. Will Woodrow (Director & Principal Ecologist) provided guidance and supervision throughout the project. Survey co-ordination, data management and processing were undertaken by Rachael O'Dwyer and Liam Bliss.

Ornithological surveys for Graffy Wind Farm were conducted by a bird survey team from Woodrow. All the surveys were undertaken by appropriately experienced ornithological surveyors and Woodrow staff were assisted by trusted sub-contracted fieldworkers regularly utilised by the company. The list of personnel that conducted ornithological surveyors for Graffy WF from October 2018 to August 2020 included: Jamie Bliss (JB), Hazel Doyle (HD), Hugh Delaney (HPD), Mike Trewby (MT), Robert Vaughan (RV) and Ken Westman (KW). Survey effort detailed in **Appendix 2** can be traced to surveyors by their initials.

Will Woodrow is a Director and Principal Ecologist at Woodrow Sustainable Solutions Ltd. He worked with the RSPB in the UK, in different capacities between 1985 and 2001, including managing nature reserves, working as a Conservation Officer in the East Anglia Region and working in Head Office within the Reserves Ecology and Species and Habitat Policy teams. Will has been running his own consultancy since 2004, and has built up a large body of experience in the field of ecological impact assessment. Will is a Chartered Ecologist and full member of the Chartered Institute of Ecology and Environmental Management (CIEEM); and has completed an HND in Conservation Management (1989), an MSc in European Environmental Policy & Regulation. Lancaster University in 1994 and an MSc (Arch) in Advanced Environmental & Energy Studies at the University of East London (2006).

Mike Trewby is a Senior Ecologist with Woodrow and is the company's lead ornithologist and field work manager. Mike worked for Birdwatch Ireland from 2003 to 2010 conducting research on red-billed chough, red grouse and breeding seabirds. Prior to joining Woodrow in 2016, Mike worked as an independent ornithological consultant and he has over 20 years fieldwork and research experience in the field of ecology, including nearly 10 years of undertaking, and latterly supervising, bird surveys on over 30 wind farm sites across Ireland, employing the accepted SNH guidelines. Mike regularly undertakes impacts assessments for large scale developments and is a full member of CIEEM; and his qualifications include a Post Grad. Dip. in Environmental Studies at University of Strathclyde (2002) and B.Sc. in Zoology & Botany from University of Namibia (1997).

10(II) 1 INTRODUCTION - AVI-FAUNA TOPIC

10.(ii).1 In order to comply with the requirements of the EU Habitats Directive 1992 and the EC Habitats Regulations 2011, wind farm applications in Ireland need to be assessed as to their potential impact on bird populations.

10.(ii).2 This Section of the Biodiversity Chapter addresses the potential ecological impacts on avian populations utilising the area of an eight-turbine wind farm development proposed for Graffy Hill and adjoining townlands along the lower southern slopes of An Eachla (Aghla Mountain), *c.* 8 km east of Na Gleannta (Glenties), Co Donegal. The central grid reference for the site is IGG 90603-97329 [Lat. 54.8238, Long. -8.1469]. The proposed wind turbines (WT) are located within the following townlands: An Dearachán Mór - Dalraghan More (WT01, WT02), Min na Manrach - Meenamalragh (WT03, WT04, WT05, WT06) and An Ghrafaidh - Graffy (WT07, WT08). A sub-station is proposed just south of the L-6743 in the townland of Meenagrubby – Mín Ghriobaigh and the proposed grid connection route follows local roads (*c.* 4.4 km) and Coillte tracks (*c.* 2.5 km) to the existing Tievebrack sub-station. A permanent meteorological mast will be erected at the location of the temporary mast in the townland of Graffy- An Ghrafaidh.

10.(ii).3 To inform the impact assessment at the proposed development a range of bird surveys were undertaken including a desk-based study and field surveys. The appropriate methodological approach for assessing bird population on proposed wind farm sites is SNH (2017) *Recommended Bird Survey* Methods *to Inform Impact Assessment of Onshore Wind Farms* and SNH Guidance Note, which provides updates to SNH (2009) and SNH (2014). Ornithological surveying for Graffy Wind Farm from October 2018 to August 2020 provides two years of data in compliance with SNH guidelines.

10.(ii).4 **Figure 1** to **Figure 5** in **Appendix 1** shows the extent of the various ornithological study areas (500 m, 2 km and 6 km turbine buffers) in relation to the proposed turbine layout and associated site infrastructure and the proposed works corridor. While this Section covering Avi-fauna provides an overview of the site layout and turbine specification, please refer to **Chapter 2** for the complete description of the proposed development.

10.(ii).5 This Section of the Biodiversity chapter covering Avi-fauna has been undertaken with full account of legislation, policy and guidance relating to species and habitat protection, importance and survey protocol; and includes the following:

International legislation

- EU Council Directive 92/43/EEC on the Conservation of Natural Habitats and of wild flora and fauna (*Habitats Directive*)
- EU Council Directive 2009/147/EC on the Conservation of Wild Birds (*Birds Directive*)

- Environmental Impact Assessment Directive (2011/92/EU)
- Environmental Impact Assessment Directive (2014/52/EU)
- Bern Convention (1982) - The Convention on the Conservation of European Wildlife and Natural Habitats
- Bonn Convention (1979, enacted 1983) - The Convention on the Conservation of Migratory Species of Wild Animals
- Ramsar Convention (1971) The Convention on Wetlands of International Importance
- UN Convention on Biological Diversity (CBD) – 1993

National legislation

- The Wildlife Act (1976) and amendments
- EC (Birds and Natural Habitats) Regulations 2011 (transposing the Birds Directive and Habitats Directive into Irish law)
- Planning and Development Acts 2000, as amended

National policy

- The National Heritage Plan (published in 2002)
- The National Biodiversity Action Plan 2017-2021 (NBAP)

Regional and local policy

- The Border Regional Authority - Regional Planning Guideline (2010-2022)
- Donegal County Council (2018). County Donegal Development Plan 2018-2024, specifically Natural Heritage Objectives and Policy. Note: At the time undertaking this assessment there was no County Donegal Biodiversity Action Plan (BAP).

Relevant guidance and information

- CIEEM (2018, updated 2019). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal.
- Percival, S. M. (2003). *Birds and wind farms in Ireland: A review of potential issues and impact assessment*. Ecology Consulting, Coxhoe, Durham
- Colhoun, K., & Cummins, S. (2013). Birds of Conservation Concern in Ireland 2014-2019. *Irish Birds*. 9: 523-544 – updated by BoCCI 2020-2026 (Gilbert *et al*., 2021)
- DoEHLG (2010). Appropriate Assessment of Plans and Projects in Ireland – Guidance for Local Authorities.
- DHPLG (2019) Draft Revised Wind Energy Development Guidelines.
- EPA (2002). Guidelines on the information to be contained in Environmental Impact Statements; as revised by EPA (2017), Draft revised guidelines on the information to be contained in Environmental Impact Statements.
- European Commission (2011). Wind Energy Developments and Natura 2000 Sites - EU Guidance on wind energy development in accordance with the EU nature legislation.
- Gilbert, G., Stanbury, A. & Lewis, L. (2021). Birds of Conservation Concern in Ireland 2020-2026. *Irish Birds* 9: 523-544 – updates BoCCI 2014-2019 (Colhoun & Cummins *et al*., 2013)

- Mc Guinness, S., Muldoon, C., Tierney, N., Cummins, S., Murray, A., Egan, S. & Crowe, O. (2015). *Bird Sensitivity Mapping for Wind Energy Developments and Associated Infrastructure in the Republic of Ireland*. Guidance Document. Birdwatch Ireland
- NRA (2009). Guidelines for Assessment of Ecological Impacts of National Road Schemes (Revision 2). National Roads Authority.
- Scottish Natural Heritage (2009). *Monitoring the Impact of Onshore Wind Farms on Birds*. SNH.
- Scottish Natural Heritage (2014). *Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms*. SNH Guidance Note (2014 update), SNH.
- Scottish Natural Heritage (2016). *Assessing Connectivity with Special Protection Areas (SPAs)*. Guidance (Version 3). SNH
- Scottish Natural Heritage (2017). *Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms*. SNH Guidance Note (2017 update). SNH.
- Scottish Natural Heritage - SNH (2018a). *Assessing the cumulative impact of onshore wind farms on birds*. Guidance SNH
- Scottish Natural Heritage - SNH (2018b). *Assessing significance of impacts from onshore wind farms out-with designated areas* (Version 2). Guidance SNH.

- **Section 10(ii) 3.1** provides a list of reference material used to undertake the desk-based study.

10(II) 2 OUTLINE OF THE SCOPE OF WORKS

10(ii) 2.1 Overview

10.(ii).6 Woodrow Sustainable Solutions Ltd. was commissioned by Cuilfeach Teoranta (the Applicant) to compile the Avian Ecology Section of the ES for the Proposed Development; as well as, to conduct ornithological surveys from October 2018 to August 2020 inclusive. The survey regime provides four seasons of ornithological data to inform the ornithological baseline for this proposed wind farm site and covers the following seasons:

- Non-breeding season 2018-19: October 2018 to March 2019
- Breeding season2019: March to August 2019
- Non-breeding season 2019-20: October 2019 to March 2020
- Breeding season 2020: March to August 2020

10.(ii).7 The current Application Site is encompassed within a recently withered planning consent for a wind farm that would have involved the construction of more wind turbines (13 turbines) over a wider area. The revised proposal seeks to reduce the number of wind turbines to eight, with a design specification that will facilitate greater energy generating capacity through increasing the blade lengths of the proposed turbines.

10.(ii).8 As manufactures are continually modifying turbine specifications, two turbine models are proposed, namely the Enercon 126 and the Nordex 133, to ensure that at least one of the turbine types will still be available for construction. For the turbine set ups being considered, the combination of blade length relatively to hub heights will not exceed tip heights of 150 m, which results in minimum swept heights ranging from 18.0 to 34.15 m depending on the model(s) that will be erected. Unless otherwise stated, the impact of the proposed wind farm has been assessed using the maximum dimensions for the rotor swept area which is 18 to 150 m; i.e., presenting the worst-case scenario for avian collision risk. Please note that although turbine makes and models are specified, the bird data collected and impact assessment can be adjusted for alternative turbine dimensions, as well as changes to site layout.

Survey methods followed those detailed in SNH (2009)[1] and were designed to be compliant with updated guidelines SNH (2014)[2] and SNH (2017)[3]; with the ornithological surveys spanning four seasons (2018 to 2020) and incorporating the following methodologies:

- Vantage point watches covering an area within 500 m of proposed turbine location to generate flight line information on target species for collision risk modelling as per the Band Model (Band *et al.*, 2007 & SNH, 2000)[4 5] and employing avoidance rates, as detailed in SNH (2016)[6] and SNH (2018)[7].
- Breeding season walkovers employing adapted Brown & Sheppard[8, 9] and O'Brien & Smith (1992)[10] methodology to survey for upland breeding birds and breeding waders (specifically snipe), respectively and covering suitable habitat up to 800 m from proposed turbine locations.
- Non-breeding season walkovers covering up to 500 m from proposed turbine locations.
- Breeding raptor surveys as detailed in Hardey *et al.* (2013)[11] within 2 km of the proposed turbine locations for all species of raptor, with the search area extended to 6 km specifically targeting breeding eagles.
- Breeding red throated diver surveys as detail in Gilbert *et al.* (1998)[12] covering loughs within 2 km of the proposed turbine locations, which is beyond the SNH (2017)[13] recommended 1 km search area. A 2 km search area is in line with bird sensitivity mapping for wind farm developments (McGuinness *et al*, 2015)[14] and when considering connectivity with SPAs (SNH, 2016)[15]
- Non-breeding season wintering waterbird surveys covering wetland habitats and potential foraging habitats within 5-6 km of the proposed turbine locations.

1 Scottish Natural Heritage (2009). *Monitoring the Impact of Onshore Wind Farms on Birds*. SNH.

2 Scottish Natural Heritage (2014). *Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms*. SNH Guidance Note (2014 update). SNH.

3 Scottish Natural Heritage (2017). *Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms*. SNH Guidance Note (2017 update), SNH.

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

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

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

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

8 Brown, A.F. & Shepherd, K.B. (1993). A method for censusing upland breeding waders. *Bird Study*, 40: 189-195.

9 Calladine, J., Garner, G., Wernham, C. & Thiel, A. (2009) The influence of survey frequency on population estimates of moorland breeding birds. *Bird Study*, 56: 3, 381-388.

10 O'Brien, M. & Smith, K.W. (1992) Changes in the status of waders breeding on wet lowland grassland in England and Wales between 1982 and 1989. *Bird Study* 39: 165-176.

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

12 Gilbert, G., Gibbons, D.W., Evans, J. (1998). *Bird Monitoring Methods – A manual of techniques for key UK species*. RSPB.

13 Scottish Natural Heritage (2017). Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms. SNH Guidance Note (2017 update), SNH.

14 Mc Guinness, S., Muldoon, C., Tierney, N., Cummins, S., Murray, A., Egan, S. & Crowe, O. (2015). Bird Sensitivity Mapping for Wind Energy Developments and Associated Infrastructure in the Republic of Ireland. Guidance Document. Birdwatch Ireland

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

10.(ii).9 This report uses the following the terminology to describe the occurrence of avi-fauna in relation to the proposed development:

- The ***core ornithological study area*** is considered as an aggregated area extending out 500 m from each of the proposed turbine locations and is termed the ***500 m turbine buffer***, which is sometimes referred to as the ***turbine envelope***. This is the area assessed in terms of collision risk for birds and is considered to be zone of influence for this element of the assessment.
- The ***wider area*** sometimes referred to as the ***hinterland*** is the area surrounding the wind farm site that is surveyed at a range of spatial scales and in difference seasons depending on the ornithological feature of interest being assessed. The spatial and temporal parameters of wider area surveys are defined in the section covering methodologies, and include the following areas:
  - 800 m turbine buffer – breeding waders
  - 2 km turbine buffer – breeding raptor, breeding red throated divers
  - 6 km turbine buffer – breeding eagles
  - 5-6 km turbine buffer – wintering waterbirds
- The proposed development is referred to as the ***wind farm site***, which broadly refers to the area of the 500 m turbine buffer (turbine envelope), and does not, unless specifically referred to, include the length of the grid connection route extending beyond the 500 m turbine buffer. The cabling for grid connection will be installed underground, and therefore this element of the proposal is not subject to the same collision risk assessment, as the wind farm site. Where appropriate the term Application Site is used to refer to all elements of the proposed development, as submitted to the planning authority.
- The term ***construction/works corridor*** is used to refer to the footprint over which the proposed project will exert a direct influence on the ecology of the area and encompasses all of the elements of the proposed construction works, including: the turbine array, hardstands, permanent assess tracks, sub-station, met mast, grid connection route, temporary assess routes, construction site compounds and deposition areas; as shown in **Appendix 1 – Figure 1 & Figure 2**. See **Chapter 2** for the full description of the proposed development.

10(ii) 2.2 Report layout

10.(ii).10 The Avi-fauna Section is supported by the following Technical Appendices [in Volume 3A, Appendix 7 of the EIAR], which provide full details of the survey effort employed during the ornithological study and survey results displayed in tables and charts. The details of the collision risk model conducted are provided in **Appendix 6**. Any information pertaining to particularly sensitive species, merlin nest sites in this instance, is provided in a confidential Appendix that will be submitted to NPWS for review and can be requested if required for independent evaluation. The full list of supporting Appendices is:

- **Appendix 1** Ornithological study area
- **Appendix 2** Survey effort
- **Appendix 3** Results: Flight line maps

- **Appendix 4** Results: Site walkover maps
- **Appendix 5** Results: Wider area maps
- **Appendix 6** Collision Risk Modelling Report
- **Appendix 7** Confidential Appendix: Merlin flight-lines and nesting information

10.(ii).11 Prior to submission of this report an update to Birds of Conservation Concern in Ireland BoCCI 2014-2019 (Colhoun & Cummins, 2013)[16] was released, BoCCI 2020-2026 (Gilbert *et al.*, 2021)[17]. For species where conservation status has been upgraded or downgraded these updates have been assimilated into this impact assessment. Two species regularly recorded at Graffy were upgraded from the Amber to Red list, including kestrel and snipe. Swift were only recorded occasionally were also upgraded from the Amber to Red list. The only other species upgraded was the addition of willow warbler to the Amber list (previously Green listed).

[16] Colhoun, K., & Cummins, S. (2013). Birds of Conservation Concern in Ireland 2014-2019. *Irish Birds*. 9: 523-544 – updated by BoCCI 2020-2026 (Gilbert *et al.*, 2021)

[17] Gilbert, G., Stanbury, A. & Lewis, L. (2021). Birds of Conservation Concern in Ireland 2020-2026. *Irish Birds* 9: 523-544

10(II) 3 METHODOLOGY

10.(ii).12 The section below describes the methods used to identify and survey valued ecological receptors (protected and sensitive bird species) and how potential effects that may occur as a result of the proposal are assessed.

10(ii) 3.1 Desk top assessment

10.(ii).13 A desktop assessment of the ornithological baseline data available was undertaken using a number of sources and references:

- Balmer, D.E., Gillings, S., Caffrey, B.J., Swann, R.L., Downie, I.S. & Fuller R.J. (2013). Bird Atlas 2007–11: The Breeding and Wintering Birds of Britain and Ireland. BTO, Thetford.
- BirdWatch Ireland (2010). *Action Plan for Upland Birds in Ireland 2011-2020.* BirdWatch Ireland's Group Action Plans for Irish Birds. BWI, Kilcoole, Co. Wicklow
- Crowe, O., Musgrove, A.J. & O'Halloran, J. (2014). Generating population estimates for common and widespread breeding birds in Ireland. *Bird Study* 61(1): 82-92
- Gibbons, D. W. (1993). The New Atlas of Breeding Birds in Britain and Ireland (1988–91).
- Hutchinson, C. D. (1989). *Birds of Ireland*. T. & A. D. Poyser.
- Lewis, L. J., Coombes, D., Burke, B., O'Halloran, J., Walsh, A., Tierney, T. D. & Cummins, S. (2019a) Countryside Bird Survey: Status and trends of common and widespread breeding birds 1998-2016. *Irish Wildlife Manuals*, No. 115. NPWS, Department of Culture, Heritage and the Gaeltacht, Ireland.
- Mc Guinness, S., Muldoon, C., Tierney, N., Cummins, S., Murray, A., Egan, S. & Crowe, O. (2015). Bird Sensitivity Mapping for Wind Energy Developments and Associated Infrastructure in the Republic of Ireland
- Sharrock. J.TR. (1976). The Atlas of breeding Birds in Britain and Ireland.
- Information relating sites designated for nature conservation was reviewed using the NPWS Designation Viewer: http://dahg.maps.arcgis.com/apps/webappviewer/index.html?id=8f7060450de3485fa1c0855 36d477ba
- NPWS Site Synopsis and Conservation Objectives for the following Special Protection Areas (SPAs) surrounding the Application Site:

Derryveagh & Glendowan Mountains SPA:	https://www.npws.ie/protected-sites/spa/004039
Lough Nillan Bog SPA:	https://www.npws.ie/protected-sites/spa/004110
Sheskinmore Lough SPA:	https://www.npws.ie/protected-sites/spa/004090
West Donegal Coast SPA:	https://www.npws.ie/protected-sites/spa/004150
Inishkeel SPA:	https://www.npws.ie/protected-sites/spa/004116
Roaninish SPA:	https://www.npws.ie/protected-sites/spa/004121
Illancrone and Inishkeeragh SPA:	https://www.npws.ie/protected-sites/spa/004132
Donegal Bay SPA:	https://www.npws.ie/protected-sites/spa/004151

Durnesh Lough SPA: https://www.npws.ie/protected-sites/spa/004145
Lough Swilly SPA: https://www.npws.ie/protected sites/spa/004075

- NBDC - Biodiversity Maps https://maps.biodiversityireland.ie/
- Information on the location of wind farm developments in the wider area was review using the IWEA map-viewer: https://www.iwea.com/about-wind/interactve-map
- Ordnance Survey Mapping - GeoHive: http://map.geohive.ie/
- Aerial imagery: Bing Maps, Google Maps & Google Earth Pro
- Species specific information was gained from the following publications and reports:

Greenland white-fronted geese

- Fox, A.D., Norriss, D.W., Stroud, D.A. & Wilson, H.J. (1994). *Greenland White-fronted Geese in Ireland and Britain 1982/83-1993/94 - the first twelve years of international conservation monitoring*. Greenland White-fronted Goose Study Research Report No. 8. GWGS, Aberystwyth & NPWS, Dublin.
- Fox, A.D., Stroud, D.A., Walsh, A., Wilson, H.J., Norriss, D.W. & Francis, I.S. (2006). Recent changes in abundance of the Greenland White-fronted Goose. *British Birds* 99: 242-261.
- Fox, T., Francis, I., Norriss, D. & Walsh, A. (2018). *Report of the 2017/18 International census of Greenland white-fronted geese*. Greenland White-fronted Goose Study, Rønde, Denmark and Wexford, Ireland.
- Fox, T., Francis, I., Norriss, D. & Walsh, A. (2019). *Report of the 2018/19 International census of Greenland white-fronted geese*. Greenland White-fronted Goose Study, Rønde, Denmark and Wexford, Ireland.
- Fox, T., Francis, I., Norriss, D. & Walsh, A. (2020). *Report of the 2019/20 International census of Greenland white-fronted geese*. Greenland White-fronted Goose Study, Rønde, Denmark and Wexford, Ireland.

Red grouse

- Cummins, S., Bleasdale, A., Douglas, C., Newton, S., O'Halloran, J. and Wilson, J.W. (2010). The status of Red Grouse in Ireland and the effects of land use, habitat and habitat quality on their distribution. *Irish Wildlife Manuals* No. 50. NPWS, Department of the Environment, Heritage and Local Government, Dublin, Ireland.
- Cummins, S., A. Bleasdale, C. Douglas, S.F. Newton, J. O'Halloran & H.J. Wilson (2015). Densities and population estimates of Red Grouse *Lagopus lagopus scotica* in Ireland based on the 2006-2008 national survey. *Irish Birds* 10(2): 197-210.

Red-throated diver

- Burke, B., Crowe, O. & Newton, S.F. (2020). Rare and scarce breeding birds in Ireland in 2017 and 2018. *Irish Birds* 42: 63-70.
- Cromie, J. 2002. Breeding status of Red-throated Diver *Gavia stellata* in Ireland. *Irish Birds* 7(1): 13-20.
- Hamilton, J. 2013. *Report on the Monitoring of Breeding Success of Red-throated Divers in Co. Donegal, 2013*. NPWS - Northern Division Report.
- Perry, K.W. & Newtown, S.F. (2014). Rare Breeding Birds in Ireland in 2013 The Annual Report of the Irish Rare Breeding Birds Panel (IRBBP). *Irish Birds* 10: 63-70.

Seabirds

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

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

Golden eagle and white-tailed eagle

- Evans. R.J., O'Toole, L. & Whitfield, D.P. (2012). The history of eagles in Britain and Ireland: an ecological review of placename and documentary evidence from the last 1500 years, *Bird Study*, 59:3, 335-349
- Wilson-Parr, R. & O'Brien, I. Eds. (2016). *Irish Raptor Study Group Annual Review 2016*. IRSG 2016.
- Wilson-Parr, R. & O'Brien, I. Eds. (2018). *Irish Raptor Study Group Annual Review 2017*. IRSG 2017.
- Wilson-Parr, R. & O'Brien, I. Eds. (2019). *Irish Raptor Study Group Annual Review 2018*. IRSG 2018.

Hen harrier

- Barton, C., Pollock, C., Norriss, D.W., Nagle, T., Oliver, G.A. & Newton, S. (2006). The second national survey of breeding hen harriers *Circus cyaneus* in Ireland 2005. *Irish Birds* 8: 1-20.
- Norriss, D. W., Marsh, J., McMahon, D. & Oliver, G. A. (2002). A national survey of breeding Hen Harriers *Circus cyaneus* in Ireland 1998- 2000. *Irish Birds* 7: 1-10.
- Ruddock, M. & Dunlop, B.J., O'Toole, L., Mee, A., Nagle, T. (2012) Republic of Ireland National Hen Harrier Survey 2010. *Irish Wildlife Manual* No. 59. NPWS, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.
- Ruddock, M., Mee, A., Lusby, J., Nagle, A., O'Neill, S. & O'Toole, L. (2016). The 2015 National Survey of Breeding Hen Harrier in Ireland. *Irish Wildlife Manuals*, No. 93. NPWS, Department of the Arts, Heritage and the Gaeltacht, Ireland.

Merlin

- IRSG (2019). Merlin Survey: 2018. Wilson-Parr, R. & O'Brien, I. Eds. (2019). *Irish Raptor Study Group Annual Review 2018*. IRSG 2018
- Lusby, J., Darío Fernández-Bellon, D, David Norriss, D. & Lauder, A. (2011). Assessing the effectiveness of monitoring methods for Merlin *Falco columbarius* in Ireland: The Pilot Merlin Survey 2010. *Irish Birds* 9: 143-154
- Norriss, D.W., Haran, B., Hennigan, J., McElheron, A., McLaughlin, D.J., Swan, V. & Walsh, A. (2010). Breeding biology of breeding Merlins *Falco columbarius* in Ireland, 1986-1992. *Irish Birds* 9: 23-30.

Peregrine

- Madden, B., Hunt, J. & Norriss, D. (2009). The 2002 survey of the peregrine *Falco peregrines* breeding population in the republic of Ireland. *Irish Birds* 8:543-548.

Breeding waders

- Cox, R.B., Eddleston, C.R. & Newton, S.F. (2002). Upland Bird survey Report 2002: Donegal. *BirdWatch Ireland Conservation Report* No. 02/4.
- Lauder, A. & Lauder, C. (2020). Identification of breeding waterbird hotspots in Ireland. *Irish Wildlife Manuals*, No. 129. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.
- O'Donoghue, B.G., Donaghy, A. & Kelly, S.B.A (2019). National survey of breeding Eurasian Curlew *Numenius arquata* in the Republic of Ireland, 2015–2017. *Wader Study* 126, 43-48.

Wintering water bird distribution

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

- Boland, H. & Crowe, O. (2012). *Irish wetland bird survey: waterbird status and distribution 2001/02 – 2008/09*. BirdWatch Ireland, Kilcoole, Co. Wicklow.
- Lewis, L. J., Burke, B., Fitzgerald, N., Tierney, T. D. & Kelly, S. (2019b). Irish Wetland Bird Survey: Waterbird Status and Distribution 2009/10-2015/16. *Irish Wildlife Manuals*, No. 106. NPWS, Department of Culture, Heritage and the Gaeltacht, Ireland.

10(ii) 3.2 Field survey methodology

10.(ii).14 SNH (2017)[18] provides recommended survey methodologies for the assessment of avian populations within and adjacent to proposed onshore wind farms. The survey methodologies utilised for the various field ornithological surveys are summarised below and adhere to the relevant SNH guidance. **Appendix 2** provides further detail on the survey effort implemented for this project, including survey dates, duration and weather conditions.

10(ii) 3.2.1 Vantage Point (VP) watch methodology

10.(ii).15 VP watches aim to record flight-line activity through the proposed turbine envelope to provide data on selected target species for assessing avian collision risk.

10.(ii).16 Four VPs were selected and these were retained throughout the survey period. The VPs selected to cover Graffy Wind Farm are compliant with the SNH (2014) guidelines, which stipulate that viewsheds from VPs should not extend more than 2 km and that the angle of view should also not extend beyond an arc of 180 degrees. The four VPs provided comprehensive coverage of the rotor swept area for the entire turbine envelope – defined as a buffer extending out 500 m from the proposed turbine locations. **Figure 1** in **Appendix 1** shows the locations of the VPs and the extent of the turbine envelope (500 m turbine buffer).

10.(ii).17 The viewsheds of the VPs do overlap and in particular, the viewshed of VP4 overlaps with VP2 and VP3. Therefore, it is acknowledged that as a function of coverage (survey effort) the flight seconds reported cumulatively for all the VP watches are likely to overestimate flight time within the turbine envelope. Therefore, a correction factor has been applied to the data utilised in the collision risk model – see **Appendix 6** for details.

10.(ii).18 VP4 was employed to provide a view over the tops of forestry plantations within and adjacent to the site and specifically to provide coverage of the airspace around VP2, which was located inside the 500 m buffer. On clear days VP4 also facilitated excellent vistas towards the Blue Stacks providing data on eagle activity occurring beyond the turbine envelope. The conducting of VP watches simultaneous by two surveyors was avoided as much as possible and over the two-year study, simultaneously VP watches were only undertaken on 10 out of 98 survey days. When simultaneous VP watches did occur, care was taken to ensure that the viewsheds of the VPs did not overlap, i.e. only VP1 and VP2 covering opposite ends of the site could be done at the same time to avoid overlap. Therefore, no correction factor is required.

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18 Scottish Natural Heritage (2017). *Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms*. SNH Guidance Note (2017 update), SNH

10.(ii).19 To prevent fatigue, surveyors did not typically undertake VP watches of more than 3 hours in duration without a break, unless inclement periods of weather meant watches were paused for short durations until conditions improved. There were five occasions when VP watches did exceed 3 hours without a break and surveyors undertook continuous watches lasting 4 to 4.5 hours. However, on these occasions fatigue was judged to be minimal, as no further watches were conducted on the day. In addition, while the SNH guidelines do permit 9 hours of surveying per day, the application of this allowance was limited to five survey days over the two years.

10.(ii).20 Target species for which flight-line data was captured were defined as all raptor species and all water bird species. As such, all species with populations potentially at risk from wind farm developments were surveyed, including species of conservation concern and those susceptible to collision due to flight behaviour. Based on population sensitivity and/or proximity of the wind farm site to Special Protection Areas (SPAs), the primary target species identified for the proposed development were:

- Breeding red-throated diver, golden plover and dunlin
- Wintering Greenland white-fronted goose and whooper swan
- Raptor species: white-tailed eagle, golden eagle, hen harrier, merlin and peregrine
- As a resident red listed species likely to occur red grouse were included as primary target species.

10.(ii).21 As detailed SNH (2014)[19], it is considered that passerines are at low risk from collision from wind turbines; as flight behaviour makes them less susceptible to collisions and populations dynamics (e.g. high fecundity, rapidly attaining sexual maturity) means that any fatalities due to collision are unlikely to impact on passerine communities at the population level. The exception may be rarer breeding passerines, which in Co. Donegal would include whinchat, ring ouzel and twite. However, the small size of these species makes them difficult to detect from VPs; and therefore, walkovers or species-specific surveys (e.g. tape-lure surveys) provide a better method of accessing the baseline populations.

10.(ii).22 As detailed in **Appendix 2**, for each VP a minimum of 36 hours of watches has been collected for each season, defined as the breeding season and non-breeding season, i.e. 72 hours per year. Two years of ornithological surveys are recommended by the SNH guidelines, unless it can be clearly demonstrated that a single year of data is sufficiently robust and appropriate for assessing the potential impacts of the proposal. For this proposal data has been collected from four VPs over a

19 Scottish Natural Heritage (2014). *Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms*. SNH Guidance Note (2014 update), SNH.

period of two years spanning from October 2018 to August 2020 and amounting to 577.26 hours of watches for the site.

10(ii) 3.2.2 Collision risk modelling

10.(ii).23 Flight data for all target species was run through a collision risk model (CRM), as detailed in SNH (2000)[20] and Band *et al.* (2007)[21], employing avoidance rate as given in SNH (2016 & 2018)[22, 23] to provide estimates of the number of collisions per annum and for the life of the project (30 years). Detailed methods statement, along with results are provided in **Appendix 6**.

10(ii) 3.2.3 Breeding bird surveys

10.(ii).24 Breeding bird surveys aim to provide information on the distribution of breeding birds throughout the wind farm site and within the wider ornithological study area for selected species (raptors), highlighting the locations of potentially sensitive species to be flagged as ecological constraints, e.g. breeding waders. Various methods are employed depending on the habitat type and the expected species. For the wind farm site, walkovers through the 500 m turbine buffer employed a modified Brown & Sheppard (1993)[24, 25] methodology for upland breeding birds and incorporated visits around dawn/dusk (as per O'Brien & Smith, 1992)[26] specifically for breeding snipe and targeted wetter parts of the site. For at least one of the visits the survey area was extended to 800 m to cover the zone of potential disturbance for specific species, like breeding curlew. Additional coverage of suitable habitat within the 800 m turbine buffer was provided while undertaking VP watches from VP1, VP3 and VP4.

10.(ii).25 All birds encountered during site walkovers were recorded, along with numbers of birds and behaviour observed. Information for species encountered during walkovers was included on the species list for the site and used to inform the impact assessment. Composite (i.e. displaying data from all visits) distribution maps for Red and Amber listed breeding birds are provided in **Appendix 6**.

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

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

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

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

24 Brown, A.F. & Shepherd, K.B. (1993). A method for censusing upland breeding waders. *Bird Study*, 40: 189-195.

25 Calladine, J., Garner, G., Wernham, C. & Thiel, A. (2009) The influence of survey frequency on population estimates of moorland breeding birds. *Bird Study*, 56: 3, 381-388.

26 O'Brien, M. & Smith, K.W. (1992) Changes in the status of waders breeding on wet lowland grassland in England and Wales between 1982 and 1989. *Bird Study* 39: 165-176

10(ii) 3.2.4 Winter walkovers

10.(ii).26 Winter walkover surveys aim to provide information on the distribution of birds wintering throughout the site, highlighting the locations of potentially sensitive species to be flagged as ecological constraints. Winter walkovers are important in providing context to VP watch data and facilitate validation of bird numbers utilising the study area. Over winter 2018-19 two walkovers of the 500 m turbine buffer were undertaken, with a third just covering the proposed turbine locations and infrastructure. Over winter 2019-20 two walkovers were completed. Survey effort is shown in **Appendix 2** and the results are provided in **Appendix 4**.

10(ii) 3.2.5 Breeding season wider area raptor surveys

10.(ii).27 SNH guidelines recommend surveying the wider area (hinterland) for up to 2 km from the site for most breeding raptor species. A combination of mini-VPs, driven and walked transects were used to search the hinterland in the breeding seasons of 2019 and 2020. Given the proximity of the Application Site to known golden eagle breeding sites in the Blue Stack Mountains and on the Glencolumbkille Peninsula, the search area was extended to cover suitable habitat within 6 km of the proposed turbine locations.

10.(ii).28 Survey methods for breeding raptors follow those outlined in Hardey *et al.* 3rd Ed. (2013)[27], which for golden eagle involves undertaking surveys over the later stages of the winter to cover the early display period for this species. Survey effort is shown in **Appendix 2** and the results are provided in **Appendix 5**. Note: Observations from VP watches of the wind farm site, especially from VP4 were also provided useful information on eagle activity in the wider area.

10.(ii).29 The wider area surveys undertaken during 2019 breeding season (Year 1) were primarily targeted at identifying potential nesting habitat within the 6 km search area to be targeted with more intense surveying in Year 2. In Year 1 wider area searches concentrated on identifying breeding raptors within 2 km of the proposed turbine locations. The frequency of wider area surveys was intensified in 2020 and were specifically targeted at tracking golden eagle, as well as white-tailed eagle that were also found to be frequenting the study area in 2019. Within the search area extending beyond 2 km the breeding behaviour/ territories of more widespread and common raptor species, like sparrowhawk, kestrel and buzzard were captured opportunistically if detected during eagle surveys.

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

10(ii) 3.2.6 Breeding red-throated diver surveys

10.(ii).30 Red-throated diver are a notably rare breeding species in Ireland. The breeding distribution of this historically diminutive population is limited to a small number of traditional breeding sites on fresh water loughs located in Co. Donegal (Cromie, 2002)[28]. The desk-based study highlighted the occurrence of traditional breeding loughs within the 10-km grid square G89 that encompasses the western part of the wind farm site (Cromie, 2020 & Balmer, *et al.* 2013[29]). For the purposes of species protection breeding locations are not divulged in this report and and the closest known lough to the wind farm site is only referred to as the Glenties site.

10.(ii).31 Breeding red-throated diver are listed as a Qualifying Interest of the Derryveagh and Glendowan Mountains SPA. SNH (2016)[30] provides guidance on identifying 'connectivity' between SPAs and proposed developments, citing a breeding season foraging range of 8 to13.5 km for red-throated divers.

10.(ii).32 SNH (2017)[31] recommends that potential breeding loughs (as small as 15 m long) within 1 km of proposed wind farms are surveyed for nesting red-throated diver, employing methods detailed in Gilbert *et al.* (1998)[32] and requiring two visits, with the first visit conducted at the end of May or in June and the second visit conducted in July, with at least 14 days between surveys. Once occupancy has been confirmed, loughs are viewed from a distance (avoiding disturbance to breeding birds) to establish commuting routes to and from nest sites and foraging sites at the coast or other fresh water loughs.

10.(ii).33 There were only three loughs close to being within 1 km of proposed turbine locations, including Lough Nabrackboy which lies to the south of the wind farm site and is *c.* 1.2 km from T8 and two other loughs located above the proposed wind farm on Aghla Mountain - both referred to as Castle Lough on Discovery Series Map 11 - with one lough lying *c.* 1.2 km NW of T5 and the other located *c.* 1 km NW of T2. They were surveyed twice during the 2019 breeding season, with a single visit undertaken during the 2020 breeding season to check for occupancy.

10.(ii).34 As red-throated divers regularly alternate between breeding loughs (re-location distances of 1 km are not unusual) and given the inherent vulnerability of the small population in Co. Donegal, a decision was made to exceed the SNH guidance and extend the search area to cover loughs within 2 km of the proposed turbine locations. A survey area encompassing the 2 km turbine buffer

28 Cromie, J. 2002. Breeding status of Red-throated Diver *Gavia stellata* in Ireland. *Irish Birds* 7(1): 13-20.

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

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

31 Scottish Natural Heritage (2017). *Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms*. SNH Guidance Note (2017 update). SNH.

32 Gilbert, G., Gibbons, D.W., Evans, J. (1998). *Bird Monitoring Methods – A manual of techniques for key UK species*. RSPB.

matches the *zone of sensitivity* for red-throated divers listed in McGuiness *et al*., (2015)[33]. Employing a 2 km survey area ensured that the series loughs above the wind farm site on Aghla Mountain were covered, including: both Castle Loughs, L. Analtmore, L. Fad, L. Gal and L. Doo, as well as several unnamed small waterbodies.

10.(ii).35 Lough Ea and Lough Maddy lying to the south of the wind farm site were just at the extent of the 2 km turbine buffer and were not included in the extended survey. Neither of these loughs have been listed as traditional nesting locations used by red-throated divers. The Glenties red-throated diver site fell beyond the 2 km search area; and as North-western Division of NPWS has a programme in place to monitor traditional breeding sites, the loughs beyond 2 km were not surveyed to avoid duplication of survey effort and more importantly to limit potential disturbance of breeding birds by undertaking of multiple surveys visits.

10.(ii).36 Surveys to track the movement of red-throated divers to and from breeding sites were not required, as no loughs within the 2 km search area were found to be occupied. Furthermore, during the course of VP surveys the no red-throated diver flight lines through the wind farm site were detected.

10(ii) 3.2.7 Wider area winter waterbirds surveys

10.(ii).37 The wind farm site is not documented as supporting nationally or internationally important numbers of wintering waterbirds or any potentially sensitive wintering wetland species, especially swans or geese (Crowe 2005[34], Boland & Crowe 2012[35], Lewis *et al.* 2019b[36]).

10.(ii).38 The wind farm site was considered to fall within the potential Zone of Influence of several Special Protection Areas (SPAs) supporting wintering waterbirds, notably Lough Nillan Bog SPA (*c*. 4 to 15 km from Graffy) and Sheskinmore Lough SPA (*c*. 17 to 21 km from Graffy) – see **Figure 6** in **Appendix 1**. These two Natura 2000 sites are ecologically linked and jointly support a flock of Greenland white-fronted geese.

10.(ii).39 The bogland habitats occurring in the environs of Graffy were identified as having the potential to support certain species of wintering waterbird, including Greeenland white-fronted geese a Qualifying Interest of the Shiskinmore Lough SPA and Lough Nillan Bog SPA, as well as several other wintering waders including golden plover, lapwing and curlew. SNH (2016)[37] cite a core foraging range for wintering Greenland white-fronted geese of 5 to 8 km, which places the wind

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

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

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

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

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

farm site within the potential Zone of Influence for the Lough Nillan Bog SPA and beyond the potential Zone of Influence for the Shiskinmore Lough SPA.

10.(ii).40 For development proposals potentially within the core foraging range of QI for SPAs, SNH (2017)[38] guidance recommends in relation to Greenland white-fronted geese (as well as whooper swan, bean geese and barnacle geese) that:

> "*.....feeding distribution surveys should be undertaken in areas of suitable habitat when the survey area lies within the core foraging distance of SPAs for these species or other major roosts unless it can be established from existing data that the area is not utilised for feeding.*
>
> *Feeding distribution surveys of geese and swans should be carried out on a fortnightly basis where species are likely to be wintering, or on a weekly basis for sites where birds are likely to be present in the migration period only. The survey area should extend to 500m from the proposed development site.*"

10.(ii).41 It is considered that any potentially suitable bogland foraging habitat for Greenland white-fronted geese within the wind farm site and in excess of the surrounding 500 m turbine buffer was adequately covered during VP watches and site walkovers conducted over the winter.

10.(ii).42 In relation to assessing the impact of proposed wind farm developments on wildfowl roosts, specifically roosts utilised by geese, SNH survey guidelines recommend undertaking fortnightly roost surveys (as detailed in Gilbert *et al.* 1998)[39]. Monitoring should encompass roost sites within 1 km of the proposed development. At Graffy there are no potential suitable loughs for roosting swans or geese within 1 km of the proposed turbine locations.

10.(ii).43 Aside from Lough Nillan Bog SPA and Sheskinmore SPA, the wind farm site was considered to be beyond the potential Zone of Influence for other SPAs designated for winter birds, as listed in SNH (2016)[40].

10.(ii).44 There are several loughs located within 5 to 6 km of the wind farm site that were noted as having the potential to support roosting and/ or foraging winter waterbirds, in particular whooper swans. In order to determine density of use by wintering bird populations, and in particular to identify any foraging or roost sites for swans and geese, monthly point count surveys (in line with those employed for IWebS) were undertaken to survey all publicly accessible/ viewable loughs within *c*. 5-6 km of the proposed turbine locations.

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38 Scottish Natural Heritage (2017). *Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms*. SNH Guidance Note (2017 update). SNH

39 Gilbert, G., Gibbons, D.W., Evans, J. (1998). Bird Monitoring Methods – A manual of techniques for key UK species. RSPB.

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

10.(ii).45 The distance of loughs to the wind farm site and the low density of recorded usage over winter 2018-19, meant repeat surveys over winter 2019-20 were not deemed necessary; although monitoring at some loughs continued on an *ad hoc* basis.

10(ii) 3.2.8 Additional follow-on surveys in 2021 breeding season

10.(ii).46 After the two-year ornithological survey was completed, further site visits were conducted during the 2021 breeding season to monitoring the merlin breeding sites occupied in 2019 and 2020. This included a visit on 17-May-2021 which determined that both previously occupied nest locations were no longer in use, after which no further site visits were conducted.

10(ii) 3.3 Impact assessment methodology

10.(ii).47 The impact assessment methodology applied follows the Chartered Institute of Ecology and Environmental Management 'CIEEM' guidance (CIEEM, 2018 updated 2019)[41] and incorporates specific impact assessment methodologies, as detailed in Percival (2003)[42] which allows for a structured and objective approach to assessing potential impacts on avian populations from proposed wind farm developments.

10.(ii).48 As detailed in the sections describing the desk-based study and field survey methodologies, a pre-development description of bird populations within study area for the proposed development is provided – the ornithological baseline. The baseline provides information on the seasonal distribution of birds, including wintering and breeding populations, as well as estimations of abundance and densities of use. For some species of conservation concern assessments of habitat availability are undertaken.

10.(ii).49 Percival (2003) requires that an evaluation is undertaken of the population status and trends for the bird species recorded to determine the nature conservation importance, which is based on links to European Sites (Natura 2000 Site), Annex 1 status on EC Birds Directive and conservation status as listed on the BoCCI - Bird of Conservation Concern in Ireland 2014-2019 (Colhoun & Cummins, 2013)[43], which has been updated by BoCCI 2020-2026 (Gilbert *et al.*, 2021)[44]

10.(ii).50 Other more recent publications were also reviewed to provide up to date population assessments, including those in Crowe *et al.* (2014)[45] and Lewis *et al.* (2019a)[46] and species-specific studies, e.g. the results of National breeding hen harrier surveys conducted every 5 years and annual reports published by the Greenland White-fronted Goose Study. Summaries for wintering waterbird populations are provided by Crowe (2005)[47], Boland & Crowe (2012)[48] and Lewis *et al.* (2019b)[49])

10.(ii).51 BoCCI (2014-2019), is the agreed list of priority bird species for conservation action on the island of Ireland produced by BirdWatch Ireland and the RSPB Northern Ireland. Birds are classified into three separate lists (Red, Amber and Green), based on the conservation status of the bird and, hence,

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41 CIEEM (2018, updated 2019). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal.

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

43 Colhoun, K., & Cummins, S. (2013). Birds of Conservation Concern in Ireland 2014-2019. *Irish Birds*. 9: 523-544.

44 Gilbert, G., Stanbury, A. & Lewis, L. (2021). Birds of Conservation Concern in Ireland 2020-2026. *Irish Birds* 9: 523-544

45 Crowe, O., Musgrove, A.J. & O'Halloran, J. (2014). Generating population estimates for common and widespread breeding birds in Ireland. *Bird Study* 61(1): 82-92

46 Lewis, L. J., Coombes, D., Burke, B., O'Halloran, J., Walsh, A., Tierney, T. D. & Cummins, S. (2019a) Countryside Bird Survey: Status and trends of common and widespread breeding birds 1998-2016. *Irish Wildlife Manuals*, No. 115. NPWS, Department of Culture, Heritage and the Gaeltacht, Ireland.

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

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

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

conservation priority. Red List birds are of high conservation concern, Amber List birds are of medium conservation concern and Green List birds are not considered to be threatened. There are currently 31 Red listed species and 91 Amber listed species. Crowe *et al.* (2014) and Lewis *et al.* (2019a) provides more up to date details on the status and population trends for some species and is based in the results of the Countryside Bird Survey (CBS) between 1998 and 2016.

10.(ii).52 The process of ascertaining whether a potential effect is significant or not employed by Percival (2003) and used here, requires certain factors to be taken into account:

- The nature conservation importance of the species present and potentially affected; and
- The magnitude of the potential effect.

10.(ii).53 By integrating the assessments on nature conservation importance and magnitude of effects, the significance of impacts can be ascertained taking account of species considerations such as population and trends.

10.(ii).54 Stages of the assessment process are laid out in **Section 10(ii) 3.3.2** to **Section 10(ii) 3.3.6**. Tables provided here have not been changed from those put forward by Percival (2003). Notes on interpreting the significance outcomes are provided in **Paragraph 10.(ii).65**.

10(ii) 3.3.1 Identifying ecological features within the Zone of Influence

10.(ii).55 Information acquired during the desk-study and field surveys determines those ecological features which have the potential to be affected by the proposal and as such, occur within the potential 'zone of influence - ZoI' of the proposed development.

10.(ii).56 The zone of influence (ZoI) depends on the type of development taking place, its likely impacts and the presence of ecological connections which provide a pathway for such impacts to an ecological feature of interest which is sensitive to such impacts. As such, the zone of influence may extend beyond the boundaries of the application site due to the presence of ecological connections with an ecological feature of interest. Similarly, ecological features which have no ecological connection with the proposal, and as such no pathway for impacts, are not within the zone of influence regardless of their proximity to the proposed development. Any such ecological connections which provide pathways for impacts on bird populations are identified and described as part of the impact assessment.

10.(ii).57 As outlined in the section covering survey methodology, the potential zone of influence for sensitive avian receptors is determined by SNH guidance, and must also consider connectivity to nature conservation sites designated for their ornithological importance. In summary the potential ornithological zones of influence investigated as part of this study included:

- The collision risk zone for sensitive avian species is defined as a buffer extending 500 m from proposed turbine locations and is referred to as the 500 m turbine buffer or the turbine envelope.
- For breeding waders, specifically golden plover, dunlin and curlew a buffer extending 800 m from proposed turbine locations was employed as the potential ZoI.
- For breeding raptors, including hen harrier, peregrine merlin, as well as buzzard, sparrow and kestrel a buffer extending 2 km from proposed turbine locations was employed as the potential ZoI (2 km turbine buffer).
- For breeding raptors, including golden eagle and white-tailed eagle a buffer extending 6 km from proposed turbine locations was employed as the potential ZoI (6 km turbine buffer).
- For wintering waterbirds a buffer extending 5-6 km from proposed turbine locations was employed as the potential ZoI; which deviates from SNH guidance that only considers geese and swans with 500 m (foraging) and 1 km (roosting).
- The ornithological study area covering the 2 to 6 km turbine buffers, is often referred to as the wider area or hinterland.

10(ii) 3.3.2 Nature Conservation Importance

10.(ii).58 The sensitivity of bird species present at the proposed development was determined according to the definitions given in **Table 1**, based on Percival (2003). Percival (2003) pre-dates the re-introduction of white-tailed eagles into Ireland, which commenced in 2007; and as such, this species does not feature in **Table 1**. As for golden eagle, it is considered that white-tailed eagles are a species exhibiting ecologically sensitivity to wind farm developments, due to a small (pioneering population); therefore, it is appropriate that the Irish population should be classed as having *High* sensitivity

Table 1. Determining factors of avian sensitivity – Nature Conservation Importance (Source: Percival, 2003)

Sensitivity	**Definition**
Very High	• Species that form the cited interest of Special Protection Areas (SPAs) & other statutorily protected nature conservation areas.
High	• Species that contribute to the integrity of an SPA but which are not cited as species for which the site is designated. • Ecologically sensitive species including: divers, common scoter, hen harrier, golden eagle, red-necked phalarope, roseate tern & chough. • Species present in nationally important numbers (>1% Irish population).
Medium	• Species on Annex 1 of the EC Birds Directive. • Species present in regionally important numbers (>1% regional (county) population). • Other species on the BirdWatch Ireland's red list of Birds of Conservation Concern (that are not already included in a category above).
Low	• Any other species of conservation interest, including species on the BirdWatch Ireland's amber list of Bird of Conservation Concern not covered above.

10(ii) 3.3.3 Methods used to evaluate the magnitude of effects

10.(ii).59 'Effect' is considered to be a change in the population of a given bird species present during (or beyond) the life of the development. Where the effect on a population has varying degrees of likelihood, the probability of these differing outcomes needs to be considered. Effects can be adverse, neutral or favourable.

10.(ii).60 The overall magnitude of effects is determined by taking three factors into account:

- The behavioural sensitivity of the species;
- The spatial magnitude of the effect;
- The temporal magnitude of the effect.

10.(ii).61 Behavioural sensitivity is related to a species' ecological function and behaviour, and is defined using the broad criteria set out in **Table 2**. The judgement takes account of information available on the responses of birds to various stimuli (e.g. predators, noise and disturbance by humans). Behavioural sensitivity can differ even between similar species and within a particular species. Some populations and individuals may be more sensitive than others notably with respect to certain activities (such as the early stages of nesting).

10.(ii).62 Effects are also judged in terms of magnitude in space and time. Five levels of spatial magnitude are defined in **Table 3** and temporal magnitude is defined in **Table 4**.

Table 2. Determining factors for behavioural sensitivity
(Source: Percival, 2003)

Behavioural sensitivity	Definition
High	• Species or populations occupying habitats remote from human activities, or that exhibit strong and long-lasting reactions to disturbance events (guide: >20 minutes).
Moderate	• Species or populations that appear to be warily tolerant of human activities or exhibit short-term reactions to disturbance events (guide: 5-20 minutes).
Low	• Species or populations occupying areas subject to frequent human activity and exhibiting mild and brief reaction (including flushing behaviour) to disturbance events.

Table 3. Table showing the scales of spatial magnitude
(Source: Percival, 2003)

Sensitivity	Definition
Very High	• Total or near total loss of a bird population due to mortality or displacement or reduced productivity in a bird population due to disturbance. - Guide: >80% of population affected
High	• Major reduction in the size or productivity of a bird population due to mortality, displacement or disturbance. - Guide: 21-80% of population affected
Moderate	• Partial reduction in the size or productivity of a bird population due to mortality, displacement or disturbance. - Guide: 6-20% of population affected
Low	• Small but discernible reduction in the size or productivity of a bird population due to mortality, displacement or disturbance. - Guide: 1-5% of population affected
Negligible	• Very slight reduction in the size or productivity of a bird population due to mortality or displacement or disturbance. Reduction barely discernible, approximating to the "no change" situation. - Guide: < 1% population affected

Table 4. Table showing the scales of temporal magnitude
(Source: Percival, 2003)

Magnitude	Definition
Permanent	• Effects continuing indefinitely beyond the span of one human generation (taken as approximately 25 years), except where there is likely to be substantial improvement after this period (e.g. the replacement of mature trees by young trees which need >25 years to reach maturity, or restoration of ground after removal of a development. Such exceptions can be termed very long-term effects).
Temporary	• Long term (15 - 25 years or longer - see above) • Medium term (5 – 15 years) • Short term (up to 5 years)

Note: Based on Percival (2003) operational impacts of wind farms would be considered as Temporary – Long Term (with an operational time of around 25-30 years).

10(ii) 3.3.4 Methods used to determine the significance of effects

10.(ii).63 The significance of potential effects is evaluated by using reasoned argument to integrate the scales of Nature Conservation Importance (**Table 1**), behavioural sensitivity (**Table 2**) and the predicted magnitude of spatial and temporal effects (**Table 3** and **Table 4**). In making judgements on significance, consideration is given to the population status, trends and distribution of the potentially affected species within Ireland.

10.(ii).64 Inputting a combination of the bird species importance (population sensitivity) and the estimated magnitude of impact into the matrix in **Table 5** allows for the assessment of the overall impact significance on bird species at the wind farm site.

Table 5. Significance matrix: Combines effect magnitude & nature conservation importance of receptors (Source: Perc ival,2003)

Significance		**Nature Conservation Importance**			
		Very High	**High**	**Medium**	**Low**
Magnitude	**Very High**	Very High	Very High	High	Medium
	High	Very Hi gh	Very High	Medium	Low
	Moderate	Very High	High	Low	Very low
	Low	Medium	Low	Low	Very low
	Negligible	Not significant	Not significant	Not significant	Not significant

10.(ii).65 Percival (2003) suggests the following in interpreting significance ratings:

- **Not significant** is considered *de minimis* or inconsequential
- **Very low significance** and **low significance** should not normally be of concern, though normal design care should be exercised to minimise impacts.
- **Medium significance** represents a potentially significant impact that requires careful individual assessment. Such an impact could warrant planning refusal, but it may be of a scale that can be resolved by revised design or appropriate mitigation.
- **Very high significance** and **high significance** represent a highly significant impact on bird populations and would warrant refusal of a planning proposal.

10(ii) 3.3.5 Assessment of residual impacts and effects

10.(ii).66 After characterising the potential impacts of the development and assessing the potential effects of these impacts on the 'Important Ecological Features' mitigation measures are proposed to avoid and / or mitigate the identified ecological effects. Once measures to avoid and mitigate ecological effects have been finalised, assessment of the residual impacts and effects should be undertaken to determine the significance of their effects on the 'Important Ecological Features'.

10(ii) 3.3.6 Assessment of cumulative impacts and effects

10.(ii).67 Cumulative effects can result from individually insignificant but collectively significant actions taking place over a period of time or concentrated in a location (CIEEM, 2018 updated 2019). Different types of actions can cause cumulative impacts and effects. As such, these types of impacts may be characterised as:

- Additive/incremental – in which multiple activities/projects (each with potentially insignificant effects) add together to contribute to a significant effect due to their proximity in time and space (CIEEM, 2018 updated 2019).
- Associated/connected – a development activity 'enables' another development activity e.g. phased development as part of separate planning applications. Associated developments may include different aspects of the project which may be authorised under different consent processes. It is important to assess impacts of the 'project' as a whole and not ignore impacts that fall under a separate consent process (CIEEM, 2018 updated 2019).

10(ii) 3.3.7 Potential for limitations

10.(ii).68 The information contained in the Avi-fauna Section of the Biodiversity Chapter for Graffy Wind Farm, included robust data with which the likely impacts as a result of the proposed development were assessed. Where relevant, residual impacts are described in detail. No significant limitations were identified in terms of scale, scope or context in the preparation of the Avi-fauna Section.

10.(ii).69 The potential for limitations has been reviewed in relation to optimal timings for some ornithological surveys undertaken during the 2020 breeding season, as a result of travel restrictions in place during the Corvid-19 'lockdown' (activated on 27-Mar-2020). The following paragraphs examine the implications of these unavoidable alterations to survey timings with reference to CIEEM (2020)[50], which provides guidance on temporary alternative approaches to ecological survey and assessment that can be applied as a result of the Covid-19 pandemic. For reference, **Appendix 2** provides dates for survey effort employed at Graffy Wind Farm.

10.(ii).70 Based on Government travel restrictions and advice; as well as guidance from Chartered Institute of Ecology and Environmental Management (CIEEM) and the Irish Wind Energy Association (IWEA); all Woodrow ecological surveyors were stood-down from undertaking site visits over the early stages of the 2020 breeding season. The deployment of ornithological surveyors to Graffy Wind Farm was placed on hold from 27-Mar-2020 to 19-Apr-2020, after which, time critical surveys recommenced. Timings for the following breeding season surveys were delayed beyond

50 CIEEM (2020). Guidance on Ecological Survey and Assessment in the Republic of Ireland and Northern Ireland During the Covid-19 Outbreak (Version 1). Published 30 May 2020 Chartered Institute of Ecology and Environmental Management (CIEEM), Winchester, UK

the optimal survey dates in 2020 and the implications in terms of any potential limitations are assessed below:

10(ii) 3.3.7.1 Breeding season 2020 - vantage point (VP) watches

10.(ii).71 The final round of VP watches for the non-breeding season 2019-2020 were conducted between 03-Mar-2020 and 07-Mar-2020 and the distribution of survey effort was not affected by the lockdown.

10.(ii).72 The first round of VP watches for the 2020 breeding season at Graffy were scheduled for late March 2020 and had to be postponed until the recommencement of time critical surveys on 19-Apr-2020. To compensate for the late start date, 9 hours per VP were conducted from 21-Apr-2020 to 29-Apr-2020 and the recommended minimum of 36 hours per VP was achieved for all the VPs.

10.(ii).73 The spread of survey dates is compliant with SNH methodological guidelines; however, the potential for limitations arises due to the concentrated spread of survey dates. For instance there was no coverage of the study area from VPs for a period of 45 days between 07-Mar-2020 and 21-Apr-2020. This interval of time coincides with peak display periods for some target species, such as hen harriers, when there is a heightened level of flight activity that is typically followed by a lull as birds start to incubate or fail at the early stages of breeding and vacate the area.

10.(ii).74 Over this early spring period, survey effort the previous years identified a diffuse level of passage migration, including small numbers of whooper swans observed passing through the area. It is possible the gap in surveying between early Mar-2020 and late Apr-2020 resulted in this movement going undetected in the second study year. This issue was dealt with in the CRM by running the model to compensate for potentially missing the spring 2020 swan passage period, i.e. spring 2020 was attributed equivalent flight time as spring 2019.

10.(ii).75 The potential for biasing the collection of flight line data within a less active period over the breeding season has been considered. Applying professional judgement, a start date in late April although not ideal was considered to adequately cover the early stage of the breeding season for all the target species found to occur at Graffy. In addition, this time period was surveyed during Year 1 of the ornithological study. It is considered that the flight-line data generated over this time period is representative of the early breeding season, remaining compliant with SNH methodological guidance and is therefore sufficient to facilitate robust assessment of collision risk for birds utilising the proposed wind farm site.

10(ii) 3.3.7.2 Breeding season 2020 - walkover surveys

10.(ii).76 For the 2020 breeding season, the first walkover survey of the 500 m turbine buffer was undertaken over two days on 29 & 30-Apr-2020. These dates are later than the early April first visits recommended in Gilbert *et al.* (1998)[51] for undertaking Brown & Sheppard (1993) upland breeding wader surveys. However, they are considered close enough to be in line with the mid-April first visit currently recommended for conducting adapted Brown & Sheppard surveys of moorland breeding birds, as detailed in SNH (2014)[52]. Dates in late April are within the survey window for first visits when employing Dates in late April are within the survey window for first visits when employing O'Brien & Smith (1992)[53] survey methodology for lowland breeding waders, targeting territorial snipe in this instance. In addition, a comprehensive set of walkover surveys were conducted in Year 1 (breeding season 2019). Therefore, it is considered that the data collected from breeding season walkover surveys is sufficient to facilitate robust assessment of potentially sensitive bird species breeding in the environs of the wind farm site.)[54] survey methodology for lowland breeding waders, targeting territorial snipe in this instance. In addition, a comprehensive set of walkover surveys were conducted in Year 1 (breeding season 2019). Therefore, it is considered that the data collected from breeding season walkover surveys is sufficient to facilitate robust assessment of potentially sensitive bird species breeding in the environs of the wind farm site.

10(ii) 3.3.7.3 Breeding season 2020 - wider area raptor surveys

10.(ii).77 Wider area surveys for breeding raptors conducted over 2020, actually commenced in February 2020 to cover the display period for golden eagle and four full survey days were undertaken between 12-Feb-2020 and 26-Mar-2020 covering suitable breeding habitat within 6 km of proposed turbine locations. Additional observations of soaring eagles were made during VP watches, especially from VP4 that was used to opportunistically scan towards the Blue Stacks. VP4 was also strategically positioned to cover the commercial forestry plantations adjacent to the wind farm site, as areas of clear-fell and second rotation within forestry plantations provide the only potential nesting habitat for breeding hen harrier within 2 km of the proposed turbines, with the occurrence of sufficiently dense heather being limited to small patches.

10.(ii).78 H&S considerations in relation to Covid-19 meant that no wider area raptor surveys were conducted between 27-Mar-2020 and 19-Apr-2020 (43 days). As discussed above in relation to VP watches, this interval of time coincides with peak display periods for some target species, such as hen harriers and merlin. The concern here is that missing this early stage of the breeding season,

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51 Gilbert, G., Gibbons, D.W., Evans, J. (1998). Bird Monitoring Methods – A manual of techniques for key UK species. RSPB.

52 Scottish Natural Heritage (2014). Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms. SNH Guidance Note (2014 update), SNH.

53 O'Brien, M. & Smith, K.W. (1992). Changes in the status of waders breeding on wet lowland grassland in England and Wales between 1982 and 1989. *Bird Study* 39: 165-176

54 O'Brien, M. & Smith, K.W. (1992). Changes in the status of waders breeding on wet lowland grassland in England and Wales between 1982 and 1989. *Bird Study* 39: 165-176

when birds are actively displaying, can make it difficult to identify nesting sites/ breeding territories; as raptors typically become increasingly illusive as the incubation stage of the breeding season commences.

10.(ii).79 Wider area raptor surveys recommenced on 19-Apr-2020 and three full survey days were undertaken before the end of April, which to some extent covered the display stage of the breeding season for species like merlin and hen harrier. However, the number of survey days utilised was slightly less than scheduled to sufficiently cover the 2 km turbine buffer. For some less secretive (e.g. hen harrier) or habitat restricted (e.g. peregrine) raptor species, this can be compensated for by employing greater survey effort later in the season, particularly when adult birds are provisioning young and making regular nest site visits.

10.(ii).80 However, this adaption to survey effort is likely to miss breeding attempts that fail early in the season and this caveat remains as a limitation to wider area survey data collected in 2020. This adaption is also less likely to be applicable for secretive species like merlin, were nest locations are generally most effectively located during the display period (March and April). Fortunately, in relation to breeding merlin a nest site was located in the vicinity of the wind farm site during the 2019 breeding season and surveyors were able to re-locate this pair in 2020, although the site had shifted slightly between years.

10.(ii).81 For the 2020 breeding season, despite the potential for missing breeding attempts that may have failed early in the season, it is considered that the wider area raptor surveys in combination with information collected over 2019 are sufficient to facilitate robust assessment of potentially sensitive raptor species breeding in the environs of Graffy Wind Farm.

10(II) 4 BASELINE CONDITIONS

10.(ii).82 This section provides the pre-construction ornithological baseline for the proposed wind farm at Graffy Hill and is based on the finding from the desk-top study and results of the ornithological surveys conducted between October-2018 and August 2019. Detailed survey results are provided in the following Appendices:

- **Appendix 3** Results: Flight line maps
- **Appendix 4** Results: Site walkover maps
- **Appendix 5** Results: Wider area maps
- **Appendix 6** Collision Risk Modelling Report
- **Appendix 7** Confidential Appendix: Merlin flight-lines and nesting information

10(ii) 4.1 Desk-based study

10(ii) 4.1.1 Bird sensitivity mapping to wind energy development

10.(ii).83 Bird sensitivity mapping to wind energy development (Mc Guinness *et al.*, 2015)[55] is only published for the north-western boundary of the 500 m turbine buffer, which returns a low risk scoring and this classification extends over Aghla Mountain. It is important to note that this assessment only covers 22 Irish species, and of relevance to the proposed development this includes: red-throated diver, breeding waders, Greenland white-fronted goose, whooper swan, red grouse and hen harrier. However, notable omissions relevant to this region include assessments for golden eagle, white-tailed eagle and merlin.

10(ii) 4.1.2 Assessment of habitat availability for birds

10.(ii).84 In terms of habitat availability for birds, the majority of the 500 m turbine buffer would be classed as a marginalised upland site dominated by a mosaic of blanket bog, wet heath and unimproved acid grasslands that are intersected by strips of commercial forestry plantation (predominately Sitka spruce). The open, typically upland sections of the hill were sheep grazed and noted as having limited cover for ground nesting upland birds like red grouse, as well as less commonly occurring species like curlew, hen harrier and merlin.

10.(ii).85 The steep slopes and network of upland streams running through the 500 m turbine buffer means that water does not tend to collect and form any significant wetter patches. This was considered to limit the availability of potentially suitable habitat for breeding and wintering snipe. The summit

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

of Graffy Hill was a notable exception, and this area consists of a slight plateau with undulating terrain, allowing water to gather and form a series of boggy pools; although some of these have eroded out to form areas dominated by bog hags. These relatively small areas provide suitable habitat for breeding snipe; as well as superficially resembling habitat that could support breeding golden plover and dunlin; however, in view of the limited extent, proximity to low level disturbance factors and general lack of nesting cover it was considered highly unlikely that this location could support breeding golden plover or dunlin. In the northern part of the 500 m turbine buffer, the slope flattens out, on the south-east side of the L-6743 (local secondary road), and the resultant areas of bog and wet grassland were considered suitable for breeding snipe.

10.(ii).86 The northern end of the 500 m turbine buffer (T1) takes in a thin finger of young (*c.* 5 years of growth), pre-closed thicket, second rotation coniferous forestry and a larger area of notably patchy *c.* 25-year-old Sitka spruce plantation. The patchy nature of this area appears to be due to crop failure in parts, and the shallow forestry drains have resulted in relatively dense stands of ling heather developing in areas between the closed-thicket canopy. The resulting habitat structure provides a multitude of edge effects, and was assessed as one of the few locations with sufficient heather cover for ground nesting merlin and hen harrier; however, overall suitability was considered limited by the occurrence of forestry, which often facilitates higher densities of predatory terrestrial mammals, such as foxes and pine martens.

10.(ii).87 The open hill within the 500 m turbine buffer is split into two sections, by a slightly younger strip of plantation (*c.* 20 years old) that runs up the middle of the buffer. This block of forestry has entered a closed thicket stage, and is relatively dense with wide open rides along streams. Grazing by sheep and deer retains a predominately grassy understorey, although there are some patches of heathy vegetation. Several older growth short treelines and small woods associated with abandoned farmsteads have become incorporated into this commercial plantation. Notwithstanding the general negative impacts on upland habitats associated with commercial mono-crop plantations; the introduction of thin blocks of forestry onto the lower slopes of Aghla Mountain provides cover in combination with foraging opportunities in nearby bog, unimproved and semi-improved grasslands, that has the potential to offer habitat for breeding woodcock and long-eared owl; as well as a range of species favouring woodland and scrub habitats.

10.(ii).88 Several of the abandoned buildings within the 500 m buffer have retained roofs and provide potential nesting sites for species that breed in buildings, such as swallows and starlings. The highest concentration of buildings occurs between the proposed sub-station and met mast, where semi-improved grassland dominates on better drained land.

10.(ii).89 The southern end of the 500 m turbine buffer (south of T8) encompasses the area around Graffy Bridge and extends across the valley to the south bank of the Stracashel River. South of T8 the slope drops to the river valley and the semi-improved, wet grasslands in this area have received limited agricultural improvement in recent years, which combined with an intermittent to light grazing regime using cattle, has allowed species rich wet grasslands to develop in places, along with patches of scrub. Within the mosaic of wet grasslands, banks and ditches there are also patches of small woodland and short treelines, which have been allowed to mature in parts providing additional shelter and cover. This area along the river valley emerged as holding a particularly rich avi-fauna, with breeding whinchat and spotted flycatchers recorded, as well as several less rare breeding species that were not recorded away from the valley in the more upland parts of the wind farm site, including grasshopper warbler, whitethroat and sedge warbler.

10.(ii).90 The section of the 500 m turbine buffer encompassing part of the Stracashel River at Graffy Bridge has the potential to support riverine species, kingfisher, dipper and grey wagtail. The bridge provided potential nesting sites for dipper and grey wagtail; however, the river banks in the area did not provide the steep banks with exposed substrate required for kingfisher nesting burrows. Despite suitable foraging habitat kingfisher are noted as occurring from either the Owenea River or upper section of the River Finn catchments (Balmer *et al.*, 2013)[56].

10.(ii).91 Several small upland eroding streams flow through the 500 m turbine buffer providing foraging opportunities for riverine species like heron, grey wagtail and dipper, with nesting opportunities limited to a relatively short section where a stream in the north part of the site cuts through the bedrock to form steeper rocky banks. These streams flow into two different catchments, including:

- the Stracashel River that flows into the Owenea River and enters the sea at Loughros More Bay, north of Ardara
- the Stranagoppoge River that joins the River Finn and flows into the estuary of the River Foyle

10.(ii).92 The 2 km turbine buffer extends to the:

- NW of the turbine array to encompass the summit and upper north facing slopes of Aghla Mountain, including a number of small loughs identified as potential red-throated diver habitat and cliffy/crag potentially providing nesting ledges for eagles. Mountain heath, with exposed rock and some scree on the upper slopes of Aghla Mountain may provide nesting habitat for rare ringed ouzel and the area would be expected to support red grouse, as well as hares (both important prey items for golden eagles).
- SE of the turbine array to encompass the valleys of the Stracashel and Stranagoppoge Rivers, and extending as far as eastern end of Lough Ea and the upper reaches of the Owenea River. The remnants of open bog habitats are interspersed with conifer plantations, with the lower

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

lying areas along the Stracashel River being largely semi-improved agricultural grassland, with several area of wet grassland, which were considered potentially suitable for breeding curlew.

- North of T1 to encompass the northern slopes of Aghla Mountain and the steep craggy slopes above Lough Muck. This area is dominated by various ages of conifer plantation, some of which has failed in patches especially to the north where out of the plantations open blanket bog/wet heath leads down to the shores of Lough Finn. The combination of trees and bog make the area suitable for breeding merlin and is likely to support some red grouse. The patchiness of the plantations was also considered to provide some potential for breeding hen harriers and this area may be become increasingly suitable depending on forestry operations. The crags/plantation above Lough Muck could potentially provide nesting habitat for eagles.
- South and west of T8 to encompass an expanse of relatively flat blanket bog stretching beyond Lough Nabrackboy and Stracashel River valley with semi-improved agricultural grassland and plantations. The relatively extensive area of bog was considered suitable for red grouse, with wetter areas likely to be utilised by breeding snipe.

10.(ii).93 The following section provides a description of potential habitat availability for nesting eagles within the 6 km turbine buffer, which extends to the:

- SE, along the edge of the Blue Stacks, taking in the best potential golden eagle nesting habitat within the 6 km search area - associated with Silver Hill, Binnacally, Croaghubbrid (backing Lough Ea), Lavagh (Reelan River valley), Croveenananta and Boultypatrick.
- North as far as Gubbin Hill, and in the northern part of the search area potential nesting crags for golden eagle are a less prominent feature with some of the higher altitude options located on Scraigs. The combination of plantations adjacent to Lough Muck and Lough Finn may provide suitable nesting habitat for white-tailed eagle.
- NW, with highest crags available being those on the north-western slopes of Aghla Mountain, mostly lying within 2 km of the turbine array. The ridge running parallel to Lough Finn from Gubbin Hill to Curreen offers some superficially suitable crags; however, these are low as well as being relatively close to roads and human activity. Similarly, the nesting option on Croaghleheen and Gafarretmoyle were considered somewhat limited.
- South along the valleys of the Owenea and Stracashel Rivers running towards Glenties, which both have steeps slopes but offer limited crags, however the combination of steep slopes and trees may be more attractive to white-tailed eagles. There is an interesting reference to a potential traditional eagle site in Lough Anna (SE of Glenties and just within the 6 km buffer), which has a small island called Eagle Island that Evans *et al.* (2012)[57] consider to be a historical golden eagle site.
- In the area just beyond the 6 km turbine buffer (and excluding the Blue Stacks) the best nesting crags for golden eagle were considered to be in the hills north of Glenties (Crockard).

57 Evans, R.J., O'Toole, L. & Whitfield, D.P. (2012). The history of eagles in Britain and Ireland: an ecological review of placename and documentary evidence from the last 1500 years, *Bird Study*, 59:3, 335-349

10(ii) 4.1.3 Potential for connectivity with designated sites

10.(ii).94 The Application Site is not within or adjacent to any areas designated birds (SPAs), as indicated in the map in **Appendix 1** – **Figure 6**. Designated areas within 15 km of the wind farm site that have birds as a Qualifying Interest include:

- **Derryveagh and Glendowan Mountains SPA** *c*. 2.5 to 6.7 km from Graffy

- Red-throated diver	(*Gavia stellata*)	[A001] – breeding
- Merlin	(*Falco columbarius*)	[A098] – breeding
- Peregrine	(*Falco peregrinus*)	[A103] – breeding
- Golden plover	(*Pluvialis apricaria*)	[A140] – breeding
- Dunlin	(*Calidris alpina schinzii*)	[A466] – breeding

- **Lough Nillan Bog SPA** *c*. 4 to 15 km from Graffy

- Merlin	(*Falco columbarius*)	[A098] – breeding
- Golden plover	(*Pluvialis apricaria*)	[A140] – breeding
- Greenland white-fronted goose	(*Anser albifrons flavirostris*)	[A395] – wintering
- Dunlin	(*Calidris alpina schinzii*)	[A466] – breeding

10.(ii).95 **Sheskinemore Lough SPA** was included in the assessment, although this site lies *c*. 17 to 21 km from the proposed wind farm site. The only QI of this SPA are Greenland white-fronted geese, which may be ecologically linked to flocks utilising the Lough Nillan Bog SPA; and therefore, were considered as having the potential to enter the zone of influence of the proposed development.

10.(ii).96 A screening for Appropriate Assessment undertaken by RPS (2021) determined that the location of the proposed development has the potential for significant effects (as opposed to likely significant effects) on all the avian Qualifying Interests (QIs) for both Derryveagh and Glendowan Mountains SPA and Lough Nillan Bog SPA, and by virtue of potential ecological connectivity between white-fronted geese flocks, Sheskinemore Lough SPA.

10.(ii).97 As fully detailed in the Natura Impact Statement - NIS (RPS, 2021), the proposed wind farm development has the potential for direct and indirect effects on QI species, including collision risk, barrier effects and disturbance to and/or displacement of breeding or foraging QI species utilising areas adjacent to the wind farm site.

10.(ii).98 In relation to other SPA holding wintering waterbird populations > 15 km from the proposed wind farm site, SNH (2016)[58] provides the following guidance on core foraging ranges over which connectivity between QI species (geese and swans) wintering within designated sites and proposed

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

wind farm sites should be considered. McGuiness *et al.* (2015)[59] provide *zones of sensitivity* for wintering geese and swans in relation to wind farm developments.

	Core wintering range	Zone of sensitivity
• Whooper swan	5 km	600 m
• Greylag goose	15-20 km	600 m
• Pink footed goose	15-20 km	600 m
• Greenland white-fronted goose	5-8 km	600 m
• Barnacle goose	*c*. 15 km, max. up to 25 km	600 m

10.(ii).99 Based on separation distances (all SPAs > 15 km), it is considered that all SPAs designated for wintering waterbirds other than Greenland white-fronted geese are beyond the potential zone of influence of proposed wind farm site. The Inishkeel SPA, which is designated for barnacle geese was within the max. core wintering ranging for this species being *c*. 18 km from the proposed wind farm site. However, barnacle geese wintering in Ireland rarely venture more than a few kilometres from the coast and therefore the barnacles goose population associated with this SPA was considered beyond the zone of influence of the proposed wind farm site

10.(ii).100 In relation to hydrological connectivity between the wind farm site and downstream Natura 2000 sites with bird QIs; streams flowing through the northern part of the wind farm site are hydrologically linked to the Lough Foyle SPA, via the Stranagoppoge River that forms part of the River Finn catchment and flows into the SPA via the Foyle Estuary. The Lough Foyle SPA is designated for a range of wintering waterbirds, which were considered potentially sensitive to upstream water pollution. Therefore, in the absence of appropriate mitigation measures, a pollution incident or sedimentation (e.g. accidental spillage of hydrocarbons, cement/concrete entering the water course or a peat slippage) has the potential for significant effects on downstream QIs within the Lough Foyle SPA.

10.(ii).101 The hydrological connection is relatively distant (*c*. 77 km downstream); and in view of dilution effects and limited sensitivity of waterbirds receptors to low (background) levels of aquatic pollution; as well as the stringent mitigation measures that are a mandatory design phase requirement for construction works upstream of sensitive salmonid and *Margaritifera* catchments, it is considered that it is highly unlikely that QI species of the Lough Foyle SPA would be impacted during the construction, operation and decommissioning of the proposed project.

10.(ii).102 The desk-based study combined with two years of ornithological surveys covering the wind farm site and wider area determined that breeding red-throated diver, peregrine, golden plover and

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

dunlin were not recorded as occurring within or adjacent to the wind farm site. Likewise, wintering Greenland white-fronted geese were not recorded as occurring within or adjacent to the wind farm site. While there were two observations of peregrine falcon within the wind farm site and three observations of golden plover on passage recorded adjacent to the wind farm site, these were not considered to constitute any consequential ecological linkages to breeding populations within the SPAs. Therefore, for these five species, there is no link between the Application Site and designated bird populations within the Derryveagh and Glendowan Mountains SPA, Lough Nillan Bog SPA and Sheskinemore Lough SPA, and therefore no potential for adverse effects on these QI species (red-throated diver, Greenland white-fronted geese, peregrine, golden plover and dunlin) during the construction, operation and decommissioning of the proposed project.

10.(ii).103 SNH (2016)[60] recommends that connectivity to sites designated for merlin should be considered at up to 5 km. Merlin nested in a location adjacent to the wind farm site (request **Appendix 7**) and there is potential for construction, operational and decommissioning activities to result in disturbance or displacement of this pair. Displacement of this pair, could put pressure on neighbouring pairs in terms of nest site and home range competition, which could adversely affect merlin populations within both neighbouring SPAs. In the absence of mitigation there was potential for the proposed development to adversely impact on the resident pair of merlin. These potential impacts are discussed fully in the sections of the ornithological impact assessment - see **Section 10(ii) 5.3.2.2** & **Section 10(ii) 5.3.3.2**. Based on the findings of the impact assessment the NIS (RPS, 2021) concludes in relation to breeding merlin populations within the SPA, the 2019 and 2020 nesting locations were 5.2 km and 5.1 km, respectively from the boundary Lough Nillan Bog SPA at its closest point. For the Derryveagh and Glendowan Mountains SPA, the segment encompassing Lough Finn was 3.1 km and 3.3 km for sites occupied in 2019 and 2020, respectively. However, the lough does not provide suitable merlin nesting habitat and the distance for parts of the SPA encompassing suitable merlin nesting are located at 7.1 km and 7.3 km from the 2019 and 2020 nest sites, respectively. On the basis of spatial separation between the breeding site and the SPAs, which are either close to or surpass the maximum territory size of 6 km report for this species, this pair is considered unlikely to comprise a part of the population of the Lough Nillan Bog SPA and does not form a part of the population within the Derryveagh and Glendowan Mountains SPA.

10.(ii).104 Based on the desk-based study and ornithological baseline surveys, the following section provides notes on the occurrence of QI species of the Derryveagh and Glendowan Mountains SPA, Lough Nillan Bog SPA and Sheskinemore Lough SPA in relation to potential ecological links with the

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

proposed development. In particular, the notes focus on the occurrence of Greenland white-fronted geese and red-throated diver, as these species were not recorded during the course of baseline surveys; and therefore, were not included in further assessments. Notes are also provided on the potential for connectivity between the wind farm site and breeding waders (golden plover and dunlin) and breeding peregrine within the SPAs.

10(ii) 4.1.3.1 Breeding red-throated diver

10.(ii).105 Red-throated diver are a notably rare breeding species in Ireland. The breeding distribution of this historically diminutive population is limited to a small number of traditional breeding sites on fresh water loughs located in Co. Donegal (Cromie, 2002) [61], which delineate the southern extent of the species' European breeding range (Snow & Perrins, 1998) [62].

10.(ii).106 Breeding numbers in Co. Donegal for 2013 were reported as 4 pairs (Hamilton, 2013 in Perry & Newton, 2014) [63, 64], with marginally higher numbers reported in 2018, when breeding was confirmed at three sites and probable or possible breeding noted at another six loughs (Burke *et al.*, 2020) [65]. There are traditional breeding loughs located within the 10-km grid square G89, which encompasses part of the western part of the wind farm site (Cromie, 2002 & Balmer *et al.*, 2013[66]). For the purposes of species protection breeding locations are not divulged in this report and the closest known lough to the wind farm site is only referred to as the 'Glenties site'.

10.(ii).107 Breeding red-throated diver are listed as a Qualifying Interest of the Derryveagh and Glendowan Mountains SPA. SNH (2016)[67] provides guidance on identifying 'connectivity' between SPAs and proposed developments, citing a breeding season foraging range of 8 to 13.5 km for red-throated divers. The closest part of the proposed wind farm site to this SPA is a standalone section covering Lough Finn, which lies *c.* 2.5 km north of the proposed wind farm on the opposite side of Aghla Mountain; and although it may be utilised by foraging birds this lough is not noted as a traditional breeding site for red-throated diver. The main body of the SPA lies *c.* 6.7 km from the wind farm site and holds the majority of the traditional red-throated diver breeding locations in Co. Donegal. All the known breeding loughs within the SPA are distributed in the northern extent of the site,

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61 Cromie, J. 2002. Breeding status of Red-throated Diver *Gavia stellata* in Ireland. *Irish Birds* 7(1): 13-20.

62 Snow, D.W. & Perrins, C.M. (1998). *The Birds of the Western Palearctic*. Concise Edition.

63 Hamilton, J. 2013. *Report on the Monitoring of Breeding Success of Red-throated Divers in Co. Donegal, 2013*. National Parks &Wildlife Service Northern Division Report.

64 Perry, K.W. & Newtown, S.F. (2014). Rare Breeding Birds in Ireland in 2013 The Annual Report of the Irish Rare Breeding Birds Panel (IRBBP). *Irish Birds* 10: 63-70.

65 Burke, B., Crowe, O. & Newton, S.F. (2020). Rare and scarce breeding birds in Ireland in 2017 and 2018. *Irish Birds* 42: 63-70.

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

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

which are in excess of 15 km from the proposed development at Graffy, i.e. beyond the core foraging for breeding red-throated divers.

10.(ii).108 The Glenties site in the environs of the wind farm site does not fall within the Derryveagh and Glendowan Mountains SPA or any other Natura 2000 site. There are red throated diver sites reported in the Lough Nillan Bog SPA (> 5 km from the wind farm site); however, this species is not listed as QI of this SPA. Loughs in the Pettigoe uplands are also report to support breeding sites, which are > 20 km away from the wind farm site.

10.(ii).109 The baseline covered loughs within 2 km of the proposed wind farm site and no breeding red-throated divers were recorded. During VP watches no red-throated diver flight lines through the wind farm site were observed. Therefore, it is objectively concluded that the proposed development area is not important for breeding red-throated divers.

10(ii) 4.1.3.2 Winter waterbird SPAs – Greenland white-fronted geese

10.(ii).110 The wind farm site and hinterland is not documented as supporting nationally or internationally important numbers of wintering waterbirds or any potentially sensitive wintering wetland species, especially swans or geese (Crowe 2005[68], Boland & Crowe 2012[69], Lewis *et al.* 2019b[70]).

10.(ii).111 The wind farm site was considered to fall within the potential zone of influence of two Special Protection Areas (SPAs) supporting wintering waterbirds, notably Lough Nillan Bog SPA (*c.* 4 to 15 km from Graffy) and Sheskinmore Lough SPA (*c.* 17 to 21 km from Graffy) – see **Figure 6** in **Appendix I**. These two Natura 2000 sites are considered to be ecologically linked and jointly support a flock of Greenland white-fronted geese.

10.(ii).112 Historically, the dune grasslands, machair and lough at Sheskinmore have supported up to 103 Greenland white-fronted geese over the winter, with up to 53 birds from this flock recorded foraging and roosting on bogland habitats within the Lough Nillan Bog SPA (NPWS 2010[71] & 2014[72], Fox *et al.* 1994[73]). However, numbers of the Sheskinmore flock have been in decline since the 1980s. This mirrors national trends in the foraging habits of this species; as birds have shifted away from semi-natural habitats toward utilising areas with intensive agricultural grassland, cereal

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

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

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

71 NPWS (2010). Site Synopsis: Lough Nillan Bog SPA, Site Code: 004110

72 NPWS (2014). Site Synopsis: Sheskinmore Lough SPA, Site Code: 004090

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

stubbles and root crops, such as those available on the shores of Lough Swilly (Fox *et al.* 2006[74]). In recent years, monthly counts at Sheskinmore recorded a maximum of 35 birds over winter 2017/18 (Fox *et al.* 2018[75]) and only 18 birds over winter 2018/19 (Fox *et al.* 2019[76]), with low numbers and periodic usage recorded within the Lough Nillan SPA. Traditional foraging/roosting sites within the Lough Nilan Bog SPA are between 4-8 km from the proposed development.

10.(ii).113 During the baseline study no Greenland white-fronted geese were recorded foraging or roosting in the environs of the proposed wind farm site (zone of sensitivity 600 m) and no flight lines were detected through the wind farm site. Therefore, it is objectively concluded that the proposed development area is not important for wintering Greenland white-fronted geese.

10(ii) 4.1.3.3 Breeding waders - golden plover & dunlin

10.(ii).114 Golden plover and dunlin are listed as QI species of both the Derryveagh and Glendowan Mountains SPA and Lough Nillan Bog SPA. Based on surveys conducted by Cox *et al.* (2002)[77], the Lough Nillan Bog SPA supported 16 pairs of golden plover and 6 pairs of dunlin (subspecies *schinzii*); with the Derryveagh and Glendowan Mountains SPA recording 18 pairs of golden plover and 5 pairs of dunlin. Although golden plover historically bred on the hills around Finntown, the current breeding distribution within the SPAs for both species is > 10 km from the proposed wind farm site.

11.1.1 SNH (2016)[78] provides the following guidance on core breeding season ranges over which connectivity between QI wader species breeding within designated sites and proposed wind farm site should be considered. McGuiness *et al.* (2015)[79] provide *zones of sensitivity* for wintering geese and swans in relation to wind farm developments.

	Core breeding range	Zone of sensitivity
• Golden plover	3 km, max. 11 km	800 m
• Dunlin	0.5 km, max. 3 km	800 m
• Curlew	1 km, max. 2 km	800 m

10.(ii).115 The summit of Graffy Hill has small areas of superficially suitable nesting habitat for golden plover and potentially dunlin, the limited extent, proximity to low level disturbance factors and general

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

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

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

77 Cox, R.B., Eddleston, C.R. & Newton, S.F. (2002). Upland Bird survey Report 2002: Donegal. *BirdWatch Ireland Conservation Report* No. 02/4.

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

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

lack of nesting cover mean it is highly unlikely that these species would nest within the wind farm site. The upper slopes of Aghla Mountain may offer more potential; however, lough surveys did not detect breeding activity in the immediate vicinity of the site (800 m turbine buffer, which is generally considered as the ZoI for disturbance).

10.(ii).116 During the baseline study no dunlin were recorded, and three observations of golden plover were considered to be birds on passage and the flight lines did not pass through the wind farm site. Breeding habitat suitability within the wind farm site and environs (up to 800 m) was assessed as sub-optimal for both species. Therefore, it is objectively concluded that the proposed development area is not important for breeding golden plover or dunlin.

10(ii) 4.1.3.4 Breeding peregrine falcon

10.(ii).117 Peregrine falcon are listed as QI species of the Derryveagh and Glendowan Mountains SPA. Based on the National peregrine surveys conducted in 2002 (Madden *et al.* 2009)[80] the cliffs within this SPA supported 5 to 6 pairs. Based on SNH (2016)[81] the core breeding season foraging range of peregrines is 2 km, with a maximum range of 18 km.

10.(ii).118 During the baseline study peregrine observations within the wind farm site were limited to two records of birds briefly flying through the 500 m turbine buffer. The wind farm site does not hold any nesting cliffs or crags and the availability of suitable breeding habitat within 2 km of the wind farm site was assessed as limited and no breeding sites were identified within the 2 km turbine buffer. Apart from gulls attracted to the mink farm (*c.* 4 km from the wind farm site), potential prey species for peregrine (e.g. golden plover and duck species) were not found to occur in abundance in the environs of the wind farm site, and therefore the area was considered to be of limited potential to regularly attract hunting peregrines.

10.(ii).119 Based on limited availability of nesting cliffs within the 2 km turbine buffer, low densities of potential prey species and low recorded usage of the 500 m turbine buffer, it is objectively considered that the proposed development area is not important for this species, both in terms of breeding and foraging.

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80 Madden, B., Hunt, J. & Norriss, D. (2009). The 2002 survey of the peregrine *Falco peregrines* breeding population in the republic of Ireland. *Irish Birds* 8:543-548.

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

10(ii) 4.2 Summary of survey results (Oct-2018 to Aug-2020)

10.(ii).120 Over the course of the two-year ornithological study a total of 71 bird species were recorded, including seven species listed on Annex 1 of the EC Bird's Directive, 13 species that are Red listed and 21 species Amber listed on the BoCCI (2014-2019). **Table 6** provides a full species list and summary of occurrence in relation to the proposed development.

10.(ii).121 As indicated in **Table 6**, there were 33 species of birds recorded breeding within the 500 m turbine buffer and an additional 11 species recorded breeding within the 2 km turbine buffer.

10.(ii).122 Over the two-year study, no evidence of wintering Greenland white-fronted geese or breeding red-throated divers was recorded within the environs of the proposed development. The desk-based study identified these two species as primary target species for the field surveys, due to the potential for connectivity with Special Protection Areas (SPAs) in the vicinity of the proposed development, including: Lough Nillan Bog SPA and Derryveagh and Glendowan Mountains SPA. Data from field surveys combined with information of known foraging/roosting/breeding location established that these species are not ecologically linked to the area around the proposed development, nor were there any established flight paths through the wind farm site.

10.(ii).123 The seven species listed on ***Annex 1*** of the EC Bird's Directive that were recorded, included:

- whooper swan
- white-tailed eagle
- hen harrier
- golden eagle
- merlin
- peregrine
- golden plover

10.(ii).124 The 13 ***Red listed*** species (BoCCI 2014-2019) recorded, included:

Note: Base on BoCCI 2020-2026 three species (<u>kestrel, snipe and swift</u>) were added to Red list and two species of gull were downgraded to Amber list (indicated by ↓)

<u>Breeding population</u>	<u>Passage</u>	<u>Wintering population</u>	<u>Breeding & wintering population</u>
• white-tailed eagle			• golden plover
• golden eagle			• redshank
• red grouse			• curlew
• woodcock			
• black-headed gull↓			
• herring gull↓			
• grey wagtail			
• meadow pipit			
• whinchat			
• ring ouzel			

10.(ii).125 The 21 ***Amber listed*** species (BoCCI 2014-2019) recorded, included:

Note: Base on BoCCI 2020-2026 kestrel snipe and swift were upgraded to the Red list (indicated by ↑). Willow warbler has been added to the Amber list. Six species have been reassigned to the Green list (indicated by ↓)

Breeding population	Passage	Wintering population	Breeding & wintering population
• hen harrier		• whooper swan	• cormorant
• sparrowhawk↓		• jack snipe↓	• snipe↑
• kestrel↑			
• merlin			
• lesser black-backed gull			
• great black-backed gull↓			

- Amber listed (breeding) passerine species that were recorded included: goldcrest, mistle thrush↓, robin↓, skylark, spotted flycatcher, starling, stonechat↓, swallow and wheatear – Note: willow warbler was added to the Amber list
- Small amber listed non-breeding species included: swift↑ and house martin

10.(ii).126 Other species Green listed on the BoCCI (2014-2019) recorded within or directly adjacent to the site that were considered as target species, due to their classification as waterbirds or raptors, included: grey heron, mallard and buzzard.

10.(ii).127 The tally above does not include several waterbird species that occurred in the wider area, but were considered beyond the zone of influence of the proposed development, as they were recorded on loughs > 2 km from the closest turbines. Species recorded included: cormorant, little grebe, mute swan, teal, golden eye, ring necked duck, tufted duck, coot and moorhen.

10.(ii).128 Several species of conservation concern listed above that were recorded in the vicinity of the proposed wind farm site, were not regularly occurring species, including cormorant, peregrine, golden plover, redshank, curlew, black-headed gull, swift and ring ouzel. In relation to woodcock, the wintering and breeding populations are considered to be different. The declining breeding population is red listed and, while wintering birds were flushed, breeding (roding) woodcock were not recorded during surveys of the wind farm site.

10.(ii).129 Overall, the proposed wind farm site and environs were considered to be utilised at levels warranting further assessment in terms of potential impacts from the proposed development for the following species of conservation concern, which were identified as key ornithological receptors:

- Three species of wintering waterbird: whooper swan, snipe, jack snipe, woodcock
- One species of wintering wader/recorded on passage: golden plover
- Red grouse - resident
- Eight species of raptor: white-tailed eagle, hen harrier, golden eagle, buzzard, sparrowhawk, merlin, kestrel, peregrine
- One species of breeding wader: snipe

- Three species of gull (non-breeding): herring, lesser black-backed and great black-backed gulls
- Breeding assemblage of passerines, including:

- Red listed: grey wagtail, meadow pipit and whinchat
- Amber listed: goldcrest, mistle thrush, robin, skylark, starling, spotted flycatcher stonechat, swallow, wheatear (non-breeding – house martin). Note: Willow warbler now included on Amber list by BoCCI 2020-2026

Table 6. Annotated species list for the two-year bird study at Graffy Hill

Note: Species are listed alphabetically by BTO code and categories by conservation status, red, amber and green, as listed in BoCCI 2014 to 2019 (Colhoun & Cummins, 2013). Changes in conservation status based on BoCCI4 2020-2026 (Gilbert *et al.*, 2021) are noted. Any species listed on Annex 1 of the EC Bird's Directive is indicated by * following the BTO code. ● or • indicates that species was recorded exhibiting breeding behaviour within the 500 m or 2 km turbine buffer, respectively.

BTO Code	Common name	Occurrence in relation to the proposed development
Red listed species are those which are of highest conservation concern where the population is rapidly declining in abundance or range, has experienced a historic rapid decline (without recovery) or are globally threatened.		
BH	Black-headed gull	Over the two years only a single flight line was recorded of one bird commuting through the 500 m turbine buffer south of T8, in Mar-2019. There is no suitable nesting habitat for this species within the buffer or immediate environs, and the closest known breeding colonies are relatively distant being located at Inch Island (Lough Swilly), on Arranmore and Tory Island Downgraded to **Amber list**: breeding & wintering populations (BoCCI 2020-2026)
CU	Curlew	Over the two-year study there was only a single curlew recorded, which was a bird or flock heard calling in flight in Apr-2020, and was considered to be on passage, and was detected moving over the southern slopes of Aghla Mtn, above the 500 m turbine buffer. No recent breeding records within 10 km of the wind farm site, although historically (40-50 years ago) curlews were likely to have been a relatively widespread breeding species along the Stracashel River valley.
EA*	Golden eagle	Over the 2-year study golden eagle flight activity through the 500 m turbine buffer was recorded on 16 dates (19 observations) and involved several different birds including adults and sub-adults. Foraging/hunting birds were recorded utilising the turbine envelope, however birds tended to favour the upper slopes of Aghla Mtn. The site itself was considered to offer less attractive foraging opportunities, in terms of having limited cover for grouse and hare. No breeding sites were located within the 6 km turbine buffer and all known established breeding territories are located more than 6 km away from the wind farm site in the Blue Stacks, Derryvagh Mtn and S. Tooey. The closest crags are located > 2 km away from the site, above Lough Ea, Lough Finn and Lough Muck; however, it is unlikely these relatively unsecure locations would be occupied given the species propensity to select more isolated locations.
●GL	Grey wagtail	Birds were consistently recorded during the breeding season utilising the main stream flowing down the hill through the northern part of the 500 m turbine buffer, with a family group recorded in Jun-2020 confirming breeding. Upland eroding streams provide foraging opportunities for this species within the wind farm site and short sections of the main stream provide suitable nesting habitat in relatively steep sided rocky banks, otherwise availability of nest sites was assessed as limited and probably limits usage of the area to single pair. There are more opportunities for pairs to hold territories along the Stracashel and Stranagoppoge Rivers
GP*	Golden plover	No usage of the 500 m turbine buffer was recorded over the two-year study. There were a small number of observations (n = 3 obs.) of birds recorded or heard along the southern slope of Aghla Mtn., beyond the NW boundary of the buffer. The Lough Nillan Bog SPA holds the closest known breeding sites (> 10 km away from Graffy Hill).
HG	Herring gull	The occurrence of herring gulls was limited to six observation over the two years and flight time recorded in the 500 m turbine buffer was thought to be associated with gull flocks foraging and roosting at the mink farm in the valley to the WSW of the wind farm site (c. 4 km away). Sporadically, flocks of gull were observed entering the turbine envelope, circle over the SW corner and then return southwest, back towards the mink farm. Occasionally large flock (up to 150 birds). There is no suitable nesting habitat within the environs of the wind farm site and the closest known breeding sites are at the coast, *c.* 20 km away. Downgraded to **Amber list**: breeding & wintering populations (BoCCI 2020-2026)
●MP	Meadow pipit	This was the most commonly recorded breeding bird species within the 500 m turbine buffer. This ground nesting species utilises a range of heath, bog and unimproved grassland, including rank vegetation in forestry rides. Birds tend to leave the upland slopes over the autumn although small numbers were recorded throughout the winter.
•RG	Red grouse	It was estimated that the southern slopes of Aghla Mtn, above the wind farm site support 3-4 breeding territories, which stretch into the NW boundary of the 500 m turbine buffer.

BTO Code	Common name	Occurrence in relation to the proposed development
		While birds or evidence of activity was recorded in the 500 m turbine buffer, there was very limited nesting cover, and it is considered unlikely that red grouse breed on the lower slopes of Graffy Hill.
RK	Redshank	Over the two-year study there was only a single redshank record, which was a bird or flock heard calling in flight in Sep-2019, and was considered to be a passage record, and was detected moving over VP1 – south of the 500 m turbine buffer.
RZ	Ring ouzel	A single bird was recorded in Oct-2018 from VP1 and observed well south of the 500 m turbine buffer. Given the time of year, the bird was considered to be on passage. The wind farm site was assessed as not offering suitable nesting cover for this species. The closest mountainous terrain, with scree and dense heather, typically favoured by this rare breeding species in Co. Donegal, were up on the upper slopes of Aghla Mtn and were considered beyond the zone of influence.
●WC	Whinchat	Two breeding territories were identified within the 500 m turbine buffer, both to the south of T8. These pairs were utilising the wet grassland, with occasional patches of scrub that occurs on the northern bank of the Stracashel River. This area, to the east of Graffy Bridge has received limited agricultural improvement in recent years and the grazing regime appeared to be relatively intermittent to light.
WE*	White-tailed eagle	Over the two-year study, white-tailed eagles were observed within the 500 m turbine buffer on eight dates, with activity typically involving birds commuting through the site, often at heights above the rotor swept area. Usage of the site by a foraging eagle was recorded at the end of Apr-2020 and flight seconds within the turbine buffer were associated with availability of carrion (a dead sheep). Inclusive of observations beyond the turbine buffer, several different individuals have been recorded and territorial/courtship displays were observed, the closest being over the southern slopes of Aghla Mtn. It is considered that displaying behaviour observed was associated with pairs prospecting in the wider area and it is likely that pairs will be become established within 6 km of the wind farm site in the coming years; however, no breeding sites were identified over this study.
WK	Woodcock	No breeding was recorded, although the site was assessed as potentially suitable given the occurrence of commercial forestry plantations. A small number of records were generated during winter site walkovers when birds were flushed from areas adjacent to plantations.

Amber listed species are those with unfavourable European status, occur in internationally important numbers or are moderately declining in abundance or range. May also be Amber listed if population occurs in very small numbers or at limited number of sites

BTO Code	Common name	Occurrence in relation to the proposed development
CA	Cormorant	Over the two-year study only a single flight line (1 bird) was recorded adjacent to the 500 m turbine buffer. Activity in the wider area was limited to small numbers foraging on the loughs considered beyond the zone of influence. Likewise, known breeding colonies are coastal and located > 20 km from the wind farm site.
GB	Great black-backed gull	Small numbers (1 or 2 birds) were occasionally recorded commuting through the 500 m turbine buffer, with one bird recorded foraging on carrion in a ditch. As noted for the other gull species, activity within the wind farm site was thought to be associated with foraging opportunities presented by the nearby mink farm. Down graded to **Green list** (BoCCI 2020-2026)
●GC	Goldcrest	Common and widespread species breeding in conifer plantations within the wind farm site, with birds also recorded during the winter surveys
HH*	Hen harrier	Over the two-year study, hen harriers were only recorded within the 500 m turbine buffer on four dates, with all observations occurring out of the breeding season. Ringtails and males, (including an immature male) were recorded foraging through the site. No breeding activity was recorded within the 2 km turbine buffer, despite the occurrence of potentially suitable nesting cover associated with commercial forestry plantations.
HM	House martin	Recorded foraging along the Stracashel River valley adjacent to T8 during the breeding season. There were no breeding sites located within the wind farm site and most of the structures in the vicinity were considered to have limited suitability.
JS	Jack snipe	A single bird was recorded flying low at the edge of the 500 m turbine buffer in Mar-2019 and landing along a stream in the area. Small numbers of jack snipe are regularly recorded on upland sites, especially during the spring passage window.

BTO Code	Common name	Occurrence in relation to the proposed development
		Downgraded to **Green list** (BoCCI 2020-2026)
•K	Kestrel	Kestrel were regularly recorded foraging through the 500 m turbine buffer, with the south half of the wind farm site (T5 to T8) emerging as the most heavily utilised area. Flight activity was notably higher in the second study year when a pair attempted to breed in a cliffy ravine *c*. 1 km WNW of T7. Wider area surveys only found one pair attempting to breed within the 2 km turbine buffer. Up graded to **Red list**: breeding population (BoCCI 2020-2026)
LB	Lesser black-backed gull	Small numbers (1 to 4 birds) were recorded flying/commuting through the 500 m turbine buffer. No records out of the breeding season. As with other gulls, occurrence in the area was thought to be associated with foraging opportunities at the nearby mink farm.
●M	Mistle thrush	At least two breeding pairs were recorded within the 500 m turbine buffer nesting in conifer plantations and often observed foraging in the adjacent open habitat. Small flocks recorded during autumn passage and small numbers occasionally foraging in the area over the winter, especially lower lying areas along the Stracashel River. Downgraded to **Green list** (BoCCI 2020-2026)
•ML*	Merlin	One pair recorded, just beyond the 500 m turbine buffer south of T2. Different nest sites were occupied in 2019 and 2020, with corvid nests in treelines utilised. The pair successfully fledging young in both years. The majority of flight lines detected were associated with nest site activity and beyond the 500 m turbine buffer. Although observed less frequently birds were recorded throughout the non-breeding season.
●R	Robin	Common and widely distributed breeding species recorded in areas with a scrubby component, such as the edges of plantations. Birds were also recorded during the winter. Downgraded to **Green list** (BoCCI 2020-2026)
●S	Skylark	Although not as numerous as meadow pipits the open habitats within the 500 m turbine buffer supported breeding skylarks. There were no winter records of skylark, when this species moves to lower altitudes.
●SC	Stonechat	Several pairs within the 500 m turbine buffer, typically associated with patches of scrub along field boundaries. Only occasionally recorded in the area over the winter Downgraded to **Green list** (BoCCI 2020-2026)
●SF	Spotted flycatcher	One breeding territory was identified within the 500 m turbine buffer, to south of T8 towards the Stracashel River and associated with a group of trees around several abandoned cottages.
●SG	Starling	The majority of usage within the 500 m turbine buffer was associated with relatively small flocks (< 50 birds) of recently fledged birds foraging widely through the area. Breeding sites were recorded in several of the abandoned buildings.
●SH	Sparrowhawk	One breeding territory was identified within the 500 m turbine buffer, and the pair nested in conifer plantation within the northern extent of the buffer, (in the vicinity of T1). Birds were regularly recorded hunting and flying through the wind farm site. Downgraded to **Green list** (BoCCI 2020-2026)
SI	Swift	Occasionally recorded foraging through the 500 m turbine buffer during the breeding season. The area does not hold any suitable nesting habitat for this species. Up graded to **Red list**: breeding population (BoCCI 2020-2026)
●SL	Swallow	Regularly foraging through the 500 m turbine buffer over the breeding season. Nest sites identified within abandoned cottages in the area.
●SN	Snipe	Only wader species breeding within the 500 m turbine buffer; breeding at relatively low densities with at least two, possibly three territories recorded – located on slopes above T5, T6, T7 (Graffy Hill) and bog/wet grassland north of VP3. Density of use over the winter was also considered relatively low, probably a function of better wintering habitat in the wider area.
●W	Wheatear	In 2019 two possible breeding territories were identified within the 500 m turbine buffer based on singing birds, one along western side of the middle strip of plantation and the other south of T8. Breeding was confirmed along the Stracashel River, beyond the turbine buffer. No breeding activity was detected in 2020. Overall, the wind farm site was considered to offer limited nesting cover for this species, which typically requires ground level holes/crevices, which away from the coast in Ireland are often provided by earth banks, stone walls and fallen masonry around abandoned buildings.

BTO Code	Common name	Occurrence in relation to the proposed development
WS*	Whooper swan	Infrequent flight lines of small flocks (3 to 23 birds) on passage in autumn and spring occasionally passing through the wind farm site. The closest sites identified as foraging areas or roost sites were located beyond the ZoI of the proposed development (4-5 km). Possibly breeding in the wider area, again beyond the ZoI.
Green List birds are not considered threatened		
BTO Code	**Common name**	**Occurrence in relation to the proposed development**
●B	Blackbird	Although not an abundant species within the 500 m turbine buffer (due to the open, upland nature of the area), scrubby areas associated with coniferous plantation offer nesting opportunities for this species, which is considered common and widespread in the wider area. Noted wintering in the area and on autumn passage.
●BF	Bullfinch	Not recorded as breeding species within the 500 m turbine buffer, probably due to limited habitat availability. Recorded foraging in plantations over the winter and occasionally small flocks encountered taking seeds from open upland blanket bog.
●BT	Blue tit	Small number of pairs recorded breeding within the 500 m turbine buffer and foraging birds were occasionally recorded throughout the winter.
●BZ	Buzzard	Most common target species recorded during VP watches. Typically, birds recorded foraging or commuting along the site, with a relatively strong association with Stracashel River valley noted. Not found breeding within the 500 m turbine buffer, although there were some potential nesting trees. No breeding sites confirmed within the 2 km turbine buffer, with three possible sites identified in plantations adjacent to the site.
●CC	Chiffchaff	A single bird recorded within the 500 m turbine buffer in Jul-2020, and was probably moving through the area. No breeding activity was recorded and the occurrence of mature woodland favoured by this species was limited to patches around houses and along the Stracashel River valley.
●CH	Chaffinch	Common and widespread breeding species within the 500 m turbine buffer, with the relativity young coniferous plantations providing ample nesting cover. Less commonly recorded during the winter, as birds migrate and typically occur at lower altitudes.
●CK	Cuckoo	Regularly recorded during the 2019 breeding season, with a few recorded in 2020. Given the number of meadow pipits nests this site is highly suitable for breeding cuckoo.
CR	Crossbill	Recorded occasionally during VP watches, with no breeding recorded within the 500 m turbine buffer. The age of trees making up the plantations in the area were relativity young and considered unlikely to provide the significant amounts of pine cones required to sustain this species.
●CT	Coal tit	Common and widespread breeding species within the 500 m turbine buffer, with the relativity young coniferous plantations providing ample of nesting cover, as well as foraging opportunities during the winter.
●D	Dunnock	Several pairs recorded within the 500 m turbine buffer, associated with cover in scrub and was probably somewhat under recorded on transects, as this species is typically most active early in the breeding season when transects were not conducted.
FF	Fieldfare	Common and widespread wintering species, with foraging flocks often recorded along the Stracashel River valley. Largest flocks recorded during spring and autumn passage.
●GH	Grasshopper warbler	Two breeding territories were recorded within the 500 m turbine buffer, including one near Graffy Bridge (south of T8); with the other recorded at the edge of the young plantation south of VP2. The dense scrub often associated with wet ground patches, which is typically favoured by this species, was not found to be widely available and in upland areas like Graffy Hill this habitat feature can occur in pre-closed thicket plantations.
●GO	Goldfinch	Birds were recorded over both the winter and breeding season; however, no breeding territories were identified. In the vicinity of Graffy Hill this species is likely to breed along the Stracashel River valley typically utilising hedgerows, treelines or patches of woodland for nesting.
●GT	Great tit	Breeding activity (singing/calling birds) identified at several locations within the 500 m turbine buffer, with possible territories associated with patches of older trees in the lower lying parts of the site. Older trees are more likely to provide the nest holes utilised by this species.
H	Grey heron	Only occasionally recorded within the 500 m turbine buffer during VP watches. Single birds were observed flying into the area to forage along the streams flowing down the

BTO Code	Common name	Occurrence in relation to the proposed development
		slopes from T2. All observations were outside the breeding season for this species and no heronries were identified in the vicinity of Graffy Hill during wider area surveys.
●HC	Hooded crow	Commonly recorded species over both the winter and breeding season, with carrion (fallen sheep, post-lambing afterbirth, dead deer) often attracting birds into the area. Recorded breeding within 500 m turbine buffer.
J	Jay	Rarely recorded venturing up into the plantation within the 500 m turbine buffer and more regularly seen when driving to or away from the area.
●LR	Lesser redpoll	Several breeding territories located in plantations beyond the south-eastern boundary of the 500 m turbine buffer. Only one possible breeding territory located within the turbine buffer, south of T8.
•LT	Long-tailed tit	Birds were occasionally recorded in plantation backing VP2 in both winter and in the breeding season. Although there was some potentially suitable nesting cover within 500 m turbine buffer no breeding sites were located.
MA	Mallard	Rarely recorded during VP watches (two flights), with birds only observed flying along the edge of the 500 m turbine buffer. Beyond the turbine buffer birds were recorded along the Stracashel River and loughs in the wider area.
●MG	Magpie	Foraging birds regularly recorded within the 500 m turbine buffer over both the winter and breeding season. No nest sites were identified, however considered to be breeding in the area.
PE*	Peregrine falcon	Observed twice flying within the turbine envelope and only recorded occasionally during wider area surveys. No breeding sites were identified within the 2 km turbine buffer and availability of good quality nesting habitat (cliffs > 10 m) was considered limited.
●PH	Pheasant	An introduced game bird to Ireland, with one pair recorded breeding within the 500 m turbine buffer.
PW	Pied wagtail	Not regularly recorded in the area during surveys.
●RB	Reed bunting	Relatively few breeding territories identified within the 500 m turbine buffer. More breeding activity was detected along the Stracashel River valley, where nests were usually associated with areas of longer vegetation, often along ditches and drains.
•RN	Raven	Regularly recorded commuting and foraging through the 500 m turbine buffer. Breeding activity was recorded beyond the 500 m turbine buffer.
RO	Rook	Not recorded in 500 m turbine buffer, but occasionally recorded flying close to the boundary along the Stracashel River valley
SB	Snow bunting	Small numbers recorded over the winter during VP watches.
●SK	Siskin	Occasionally, picked up during VP watches, especially in the plantation backing VP2 and around T1, and possible breeding in this area.
●ST	Song thrush	Recorded breeding in the 500 m turbine buffer, seeming to favour lower lying areas south of T8 and along the Stracashel River valley, with the occasional singing bird detected from the plantations within the buffer.
●SW	Sedge warbler	Only one breeding territory recorded in 500 m turbine buffer, south of T8 towards the Stracashel River. Beyond the river there was limited suitably swampy/marshy habitat available for this species.
●TC	Treecreeper	Singing bird heard from VP2 in plantation towards T1. Limited suitable habitat within the 500 m turbine buffer for this species, which is typically associated with older growth woodland, especially broadleaved woodland.
•WH	Common whitethroat	No breeding recorded within the 500 m turbine buffer, due to the predominately open, upland nature of the site and the limited scrub cover within the 500 m turbine buffer. Small numbers of singing birds were recorded along the Stracashel River valley and south of VP2, behind the turbine buffer.
WM	Whimbrel	Bird(s) heard once on passage during a VP watch, with bird(s) passing over the slopes of Aghla Mtn, north of the 500 m turbine buffer.
•WP	Woodpigeon	Small numbers commonly recorded commuting through the 500 m turbine buffer in both winter and the breeding season. No breeding sites identified in woodland within the 500 m turbine buffer, but a small number of nest sites adjacent to the buffer were recorded.
●WR	Wren	Common and widespread breeding species through the 500 m turbine buffer where suitable cover exists. Also often recorded during the winter during VP watches.

BTO Code	Common name	Occurrence in relation to the proposed development
●WW	Willow warbler	Common and widespread breeding species through the 500 m turbine buffer, especially within the plantation. Up graded to **Amber list**: breeding population (BoCCI 2020-2026)

10(ii) 4.3 Target species accounts

10.(ii).130 The following species accounts should be read with reference to **Appendix 3**, **Appendix 4** and **Appendix 5** that provide maps displaying flight line data, walkover data and wider area data, respectively. **Appendix 6 - Table 24** provides a seasonal breakdown of flight seconds within the 500 m turbine buffer recorded for target species, including time spent within the rotor swept area. This information has been summarised within this section - see **Table 7**, as a quick reference to show overall flight times for target species in different height bands, i.e. aggregated flight time over the 2-year study. **Appendix 6** outlines the CRM – collision risk model undertaken, and **Table 13** in **Appendix 6** provides predicted collisions/mortality for target species, representative of a worst-case scenario employing Nordex 133 turbines. This included the following assumptions: 85% turbine downtime and in terms of collision risk for birds a relatively precautionary model was run which was set to flapping (0), rotor width (MaxChord: 4 m) and a relatively fast rational period (ave: 5 sec). A summary of predicted collisions is provided in the section covering operational impacts – see **Table 8**, which gives weighted values for both turbine models specified (adjusted to correct for overlapping viewsheds, turbine downtime and bird seasonal activity), with appropriate species-specific avoidance rates applied.

10.(ii).131 Over the two-year study, no evidence of wintering Greenland white-fronted geese or breeding red-throated divers was recorded in the environs of the proposed development. Data from field surveys combined with information of known foraging/roosting/breeding locations established that these species are not ecologically linked to the area around the proposed development, nor were there any established flight paths through the wind farm site. No further consideration is given to these species in the assessment and information is provided for these species in **Section 10(ii) 4.1.3** - Potential for connectivity with designated sites.

Table 7. Flight time for target species recorded within 500 m turbine buffer

Note: Flight times are shown for the original site layout, prior to the re-positioning of T1 and T2, as these flight seconds were used to run CRMs for target species. The only significant change in flight seconds was for merlin (reduced), and for all other target species with exception of greater black-backed gull flight second were reduced marginally.

*Primary target species are highlight in **Bold** (Annex I and/or BoCCI red listed), secondary target species indicted by underline (BoCCI amber listed) and BoCCI green listed target species are displayed in plain text.

Target species* No. of flight observations (No. of birds - range)	**Total flight secs in 500 m turbine buffer**		**Flight seconds in height bands (original layout)**		
	Final layout - After moving T1 &T2	**Original layout – Prior to moving T1 &T2**	**0 to 18m**	**18 to 150m CRZ**	**> 150m**
Grey heron 3 observations (Single birds)	127	136	36	100	
Whooper swan 4 observations (3 to 23 birds)	7,148	7,148		7,148	
Mallard 2 observations (2 to 3 birds)	126	126	126		
White-tailed eagle 8 observations (Single birds)	3, 334	3,694		3,144	550
Hen harrier 6 observations (Single birds)	247	296	84	212	
Sparrowhawk 11 observations (Single birds)	757	757	184	386	187
Buzzard 33 observations (1 to 2 birds)	7,915	8,011	41	7,383	587
Golden eagle 17 observations (1 to 2 birds)	4,715	4,729		3,657	1,072
Kestrel 21 observations (1 to 2 birds)	3,811	3,811	109	3,014	688
Merlin 31 observations (1 to 3 birds)	1,377	2,102 **Adjusted final T1/T2 →**	363 **218**	1,058 **578**	681 **581**
Peregrine 2 observations (Single birds)	31	31	31		
Red grouse 1 observation (Single bird)	22	22	22		
Jack snipe 1 observation (Single bird)	0	6		6	
Snipe 3 observations (Single birds)	1,339	1,339	12	1,327	
Black-headed gull 8 observations (1 to 2 birds)	124	124		124	
Lesser black -backed gull 11 observations (1 to 4 birds)	3,002	3,002		2,402	600
Herring gull 3 observations (1 to 150 birds)	20,005	20,005	105	19,500	400
Great black-backed gull 6 observations (1 to 2 birds)	1,195	1,130		1,018	112
Mixed gull flocks 1 observation (50 birds)	7,500	7,500			7,500

EU Birds Directive – Annex I species of International nature conservation value

10(ii) 4.3.1 Whooper swans BoCCI: Amber listed

10.(ii).132 **Figure 1** and **Table 1** in **Appendix 3** provide data collected during VP watches and illustrate usage of the wind farm site by whooper swans.

10.(ii).133 Usage of the 500 m turbine buffer was limited to infrequent flight lines of small flocks (3 to 23 birds) on passage in autumn (4 flight lines in October) and spring (2 flight lines in March). VP watch data generated 7,148 seconds of flight line data within the 500 m turbine buffer, all of which was determined to be at collision risk height. Flights recorded ranged in height from 30 to 150 m, with all observations noted as commuting birds on spring and autumn passage. The section on limitations (**Section 10(ii) 3.3.7**) acknowledges that due Covid-19 travel restrictions, the spring-2020 passage window was not adequately covered; however, spring-2019 is considered representative of the diffuse levels of passage migration likely to occur annually through this part of Co. Donegal.

10.(ii).134 The closest sites identified as foraging areas or roost sites were Lough Shivinagh and Lough Nambraddan, both located beyond the zone of influence of the proposed development (*c*. 5 km and *c*. 4 km, respectively). There are several loughs closer the wind farm site, within *c*. 2 km (e.g. Lough Ea and Lough Muck), however usage of these loughs was not recorded. No regularly used roost to foraging area flight lines were identified in the wind farm site.

10.(ii).135 Interestingly, during wider area breeding raptor surveys in Jul-2019 a whooper swan was recorded, suggesting that this notably rare breeding species in Ireland was nesting in the wider area. Potential breeding loughs were considered to be beyond the zone of influence of the proposed development.

10.(ii).136 Based on low recorded usage of the 500 m turbine buffer and limited use of potentially suitable roosting loughs within the 2 km turbine buffer it is objectively considered that the proposed development area is not important for wintering whooper swans.

10(ii) 4.3.2 White-tailed eagle BoCCI: Red listed

10.(ii).137 Recently re-introduced back into Ireland (2007-2011), this species is in a pioneering phase, and over the last 10 years birds have spread out from the release site in Co. Kerry to occupy breeding territories in Counties Kerry, Cork, Clare and Galway (IRSG Annual Reviews, 2016, 2017, 2018), and probably other undocumented counties, e.g. Counties Cavan/Fermanagh (Woodrow pers. obs.). White-tailed eagles are documented travelling widely and Irish wild bred birds are starting to recruit into the population.

10.(ii).138 **Figures 11** to **Figure 14** and **Table 6** in **Appendix 3** provide data collected during VP watches and illustrate usage of the wind farm site by white-tailed eagles. Information collected during wider area eagle surveys is displayed in **Appendix 5**

10.(ii).139 Over the 2-year study white-tailed eagle flight activity through the 500 m turbine buffer was recorded on seven dates (eight observations) and involved at least two adults (1 tagged/1 untagged) and an immature/ sub-adult bird, including:

- <u>Three observations</u> over the non-breeding season 2018-19

- **Obs. 1** & **2** on 30-Oct-2018: adult circles (40-80m) through site, heads along slopes of Aghla
- **Obs. 3** & **4** on 20-Mar-2019: adult commuting through site (200-100m) – tagged bird
- **Obs. 8** on 21-Mar-2019: commuted (50-120m) through site from Aghla towards Blue Stacks

- <u>Three observations</u> during the 2019 breeding season

- **Obs. 9** on 18-May-2019: hunting, then commuting through site (40-50m) mobbed by raven
- **Obs. 12** on 10-Apr-19 - 14:49: commuting, circling through site (300-200m)
- **Obs. 13** on 10-Apr-19 - 15:16: sub-adult commuting, circling through site (150-300m)

- <u>Two observation</u> over the 2020 breeding season

- **Obs. 69** on 28-Apr-2020: immature bird flying (50-100m), landing in site
- **Obs. 75, 76** & **77** on 29-Apr-2020: immature bird flying (50-180m), landing to forage on carrion

10.(ii).140 The tagged bird recorded flying through the area on 20-Mar-2019 was identified as 'Aidibheall', a female that fledged in 2014 at Mountshannon, Co. Clare. This bird had last been recorded in 2017, across the Irish Sea in Scotland and at the time, this was the first record in Ireland since. Aidibheall may have been recorded again on 10-Feb-2020 (Obs. 24 & 25) when a distant orange tag was observed on the left wing of a bird flying over crags backing Lough Ea.

10.(ii).141 Inclusive of observations beyond the 500 m turbine buffer, several different individuals have been recorded and territorial/courtship displays were observed, the closest being over the southern slopes of Aghla Mountain, when two birds locked talons and cartwheeled downwards to the north-west of the wind farm site. The tree nesting opportunities offered by the coniferous plantations within and immediately adjacent to the wind farm site were consider minimal. Although patches of mature trees and rocky cliffs/crags within 2 km of the wind farm site do offer potential nesting opportunities, no breeding sites were identified within the 2 km turbine buffer. While some of the birds recorded were definitely adult based on plumage characteristics, a high proportion were identified as immature/sub-adult. Of the adult birds recorded, based on identification wing tags it appeared that there may be several birds passing through the area. In terms of the display behaviour observed, it is also important to note, as described in Hardey *et al.* (2009) that: "*White-tailed eagles are also well-known for flight-playing (including talon-interlocking and cartwheeling) but this may be antagonistic rather than a pair displaying, and immature birds also indulge in flight-play*".

10.(ii).142 It is considered that displaying behaviour observed on the slopes of Aghla Mountain was associated with pairs prospecting in the wider area, probably testing the boundaries of potential breeding season home ranges and it is considered likely that pairs will be become established within 6 km of the wind farm site in the coming years; however, no breeding sites were identified over the study period.

10.(ii).143 It is considered that usage of the proposed wind farm site was typically by birds commuting through the area, with birds utilising the southern slopes of Aghla Mountain to soar and forage. Foraging activity, if observed within or adjacent to the wind farm site was associated with carrion on the hill.

10.(ii).144 During VP watches white-tailed eagles were recorded flying within the 500 m turbine buffer for 3,694 seconds, with 3,134 seconds judged to be at heights within the collision risk zone. The majority of this time (2,480 secs) was accounted for by a bird foraging on carrion (a dead sheep) over two consecutive days (28 & 29-Apr-2020). The carrion attracting the bird into the area was located on the edge of forestry within the north-western boundary of the 500 m turbine buffer.

10(ii) 4.3.3 Hen harrier BoCCI: Amber listed

10.(ii).145 As shown by **Figure 20** in **Appendix 3**, over the two-year study, hen harriers were only recorded within the 500 m turbine buffer on four dates, with all observation occurring out of the breeding season. No winter communal roosts were recorded in the environs, although a bird was suspected of opportunistically roosting at the edge of a forestry plantation within the wind farm site over one night. Ringtails and males, (including an immature male) were recorded foraging through the site in Dec-18, Feb-19 and possibly the same male on two dates in Aug-2020 – see **Appendix 3 – Table 10**, summarised as follows:

- 11-Dec-2018 VP watch data: ringtail – observed 3 times
- 11-Feb-2019 Walkover data: ringtail foraging low through site
- 19-Aug-2020 VP watch data: immature male
- 24-Aug-2020 VP watch data: male – observed 3 times

10.(ii).146 VP watch data generated 296 seconds of flight line data within the 500 m turbine buffer, of which only 112 seconds was determined to be at collision risk height. Collision risk (weighted and applying avoidance rate) was estimated to be exceptionally low at 0.12 collisions over 30 years.

10.(ii).147 No breeding activity was recorded within the 2 km turbine buffer over the 2-year study, and although nesting opportunities do exist these were largely associated with cover provided by commercial forestry plantations, which are generally considered sub-optimal locations for ground nesting hen harrier due to increased pressures from predation. The National hen harrier surveys (2005 to 2015) do not report breeding within the 10-km grid squares [G89 & G99] encompassing the 2 km turbine buffer and the closest breeding sites in 2015 were towards Ballybofey.

10.(ii).148 Based on low recorded usage of the 500 m turbine buffer, lack of breeding activity in the 2 km turbine buffer and no historical breeding site in the vicinity of the wind farm site it is objectively considered that the proposed development area is of limited importance for this species, both in terms of breeding and foraging.

10(ii) 4.3.4 Golden eagle BoCCI: Red listed

10.(ii).149 Golden eagles were re-introduced to Ireland between 2001 and 2012, after being persecuted to extinction *c.* 100 years ago. As detailed in Snow & Perins (1998)[82], golden eagles are considered an upland species, tending to build nests (eyries) on wide ledges of rocky crags and cliffs (up to 2), with trees sometimes also incorporated. Traditional sites in Ireland also included the use of ledges on sea cliffs. Across Europe populations are relatively sedentary, with younger or unpaired birds demonstrating nomadic or dispersive tendencies; however, this has been found to be a less prominent feature within maritime populations; as is the case with the source population of Scottish birds, which were released into Glenveagh National Park in Co. Donegal.

10.(ii).150 Pair bonds are considered monogamous, and pairs maintain a breeding season home range, where they can remain throughout the year, although they do travel further afield to forage if faced with food scarcity and will move to lower ground during periods of inclement weather. Unlike white-tailed eagles, golden eagles are less social and tend to be solitary, although some paired birds can develop cooperative hunting techniques. A wide variety of food items are reported in the diet of golden eagles (Snow & Perins, 1998), and in Ireland this is likely to include a relatively high proportion of carrion (fallen sheep and deer), along with red grouse, hare and possibly foxes. Since their introduction supplementary feeding is regularly provided for golden eagles in part of their range, including culled deer in Glenveagh National Park.

10.(ii).151 As the Irish population can still be considered to be within a pioneering phase, it is not appropriate to infer a breeding density based on the current breeding distribution. In the highlands of Scotland, where there are large expanses of suitable mountainous habitat the mean distance between eyries can be as low as 4-5 km (Snow & Perins, 1998) and Scottish breeding densities range from 4-25 pairs per 1,000 km^2 (Watson, 1997[83] in Hardey *et al.*, 2009)[84]. However, given the less expansive nature of the Irish uplands, carrying capacity is likely to be at the lower end of this range; and based

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82 Snow, D.W. & Perrins, C.M. (1998). *The Birds of the Western Palearctic*. Concise Edition

83 Watson, J. (1997). *The Golden Eagle*. T. & A.D. Poyser, London, U.K.

84 Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. & Thompson, D. (2009). *Raptors: a field guide for surveys and monitoring*. 2nd Ed. Stationery Office, Edinburgh.

on documented 19th Century records there were at least 12 known golden eagle sites in Co. Donegal in the years prior to extinction (Evans *et al.* 2012)[85].

10.(ii).152 Hardey *et al.* (2009) summaries golden eagle territories as more or less exclusive home ranges (actively defended) encompassing nest sites (1-13 alternative sites), associated hunting range and roosting sites that are occupied throughout the year. Employing radio-tracking the sizes of home ranges for Scottish pairs were found to vary from 846 to 6,687 ha (Haworth *et al.*, 2006[86] in Hardey *et al.*, 2009), and SNH (2017)[87] recommends a survey area extending 6 km from proposed wind farm developments to account for eagle home ranges, based on the 6 km range employed in Predicting Aquila Territory (PAT) modelling (see McLeod *et al.* 2002)[88].

10.(ii).153 The IRSG (Annual Reviews: 2016, 2017, 2018) and GET (Feb-2019) provide the most recent published information on golden eagle breeding densities and distribution, indicating that all the established breeding territories currently occur in Co. Donegal, with between 5-6 territories occupied from 2016 to 2019. In relation to the proposed wind farm site, the closest established breeding territories are located within the Blue Stack Mountains, Slieve Tooey (Glencolumbkille Peninsula) and Derryveagh Mountains (two territories); all in excess of 6 km from the proposed development. In recent years there have been reports of a pair establishing a territory to the west and north-west of the proposed development. Taking a measurement from the proposed operational wind farm to potential nesting habitat within this territory (i.e. distance from proposed turbine location, as is appropriate) determined that the any nesting behaviour was beyond the 6 km zone of the influence for the Application Site and likely to be as far as 10 km from any operational turbines.

10.(ii).154 Golden eagles are a slowly reproducing species (i.e. K-selected species), typically laying 2 eggs (range: 1 to 3) and often only managing to rear a single chick (Hardey *et al.* 2009, Katzner *et al.*, 2020)[89]. Over recent seasons Irish pairs have been relatively successful, with two chicks fledged in 2019 and three in both 2017 and 2018, which is an improvement on 2015 when breeding attempts failed and 2016 when only one chick fledged. It is considered that to support a viable population fledging rates need to be higher than at present and a figure of 4-5 fledgling per annum has been suggested. Since 2007 and including 2019, it is reported that 20 golden eagles have fledged;

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85 Evans. R.J., O'Toole, L. & Whitfield, D.P. (2012). The history of eagles in Britain and Ireland: an ecological review of placename and documentary evidence from the last 1500 years. *Bird Study*, 59:3, 335-349

86 Haworth, P.F, Mcgrady, M.J.,Whitfield, D.P., Fielding, A.H. & McLeod, D.R.A. (2006) Ranging distance of resident Golden Eagles *Aquila chrysaetos* in western Scotland according to season and breeding status. *Bird Study*, 53:3, 265-273

87 Scottish Natural Heritage (2017). Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms. SNH Guidance Note (2017 update), SNH.

88 McLeod, D.R.A., Fielding, A.H., Haworth, P.F., Whitfield, D.P. and McGrady, M.J. (2002). Predicting home range use by golden eagles *Aquila chrysaetos* in western Scotland. *Journal of Avian Science* 2, 183–198.

89 Katzner, T. E., M. N. Kochert, K. Steenhof, C. L. McIntyre, E. H. Craig, & T. A. Miller (2020). Golden Eagle (*Aquila chrysaetos*), version 2.0. In *Birds of the World* (Rodewald, P. G. & Keeney, B. K. Editors). Cornell Lab of Ornithology, Ithaca, NY, USA.

however juvenile mortality would be expected to be relatively high, with the BTO: BirdFacts[90] providing juvenile survival rates of 0.15 (up to 4 years of age). Age at first breeding is typically 4-5 years (Hardey *et al*., 2013)[91], when higher adult survival rates of 0.95 are sustained (BTO: BirdFacts). In 2017 the estimated population size of the Irish golden eagle population was 20-25 birds (IRSG - Annual Review 2017).

10.(ii).155 Fielding *et al* (2006)[92] researching eagles in Scotland undertook a detailed study to quantify the availability of sub-adult (non-breeding) habitat, which they described as habitat in upland regions > 6 km from occupied golden eagle nests but excluding conifer forests and lochs. Broadly applying this definition to the proposed wind farm site, which although being > 6 km away from the closest breeding site, would be considered sub-optimal for non-breeding golden eagles, being at the graduated interface between upland habitats on Aglha Mountain and the lower lying habitats of the Stracashel River valley, as well as there being a profusion of conifer plantations in the area.

10.(ii).156 The first successful breeding attempt by a wild Irish-bred golden eagle (paired with a released bird) was reported in 2017. The population is entering an interesting phase, where the released birds currently occupying breeding territories will or already have reached the end of their reproductive lives and any surviving wild bred Irish birds have begun recruiting into the breeding population. In addition, with the more productive breeding years over the three most recent seasons (2017-2019), the non-breeding (sub-adult) component of the population will have received a significant boost and these three seasons have contributed to 40% of the Irish fledged birds since 2007, which if surviving into adulthood, will go onto recruit into the breeding population.

10.(ii).157 With the recent additions to the pre-breeding component of the population, there is likely to have been an increase in the numbers of young birds without territories and these birds are aptly termed floaters, as they move nomadically between established territories. They can range relatively far, as evidenced with golden eagles being recorded within counties surrounding the release site and core breeding areas in Co. Donegal; and birds have been recorded regularly in counties within Ulster and Connaught, as well as the Buren, in Co. Clare. In addition to sub-adult floaters/unpaired nomadic birds, there will be a certain number of sub-adult birds nearing 4 years of age; these birds will be starting to form pair bonds and establish breeding territories. As the population grows, new birds will be recruiting into established territories and there is also likely to be a 'second wave' of

90 BTO – British Trust for Ornithology: Bird Facts –Golden eagle *Aquila chrysaetos*: https://app.bto.org/birdfacts/results/bob2960.htm - Robinson, R.A. (2005) *BirdFacts: profiles of birds occurring in Britain & Ireland*. BTO, Thetford (http://www.bto.org/birdfacts, accessed on 10 Jan-2021)

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

92 Fielding, A.H., Whitfield, D.P. & McLeod, D.R.A. (2006). Spatial association as an indicator of the potential for future interactions between wind energy developments and golden eagles *Aquila chrysaetos* in Scotland. *Biological Conservation* 131: 359 – 369

recruitment, with young birds setting up new territories. There is potential for these new territories to bring breeding activity closer to the proposed wind farm site at Graffy Hill.

10.(ii).158 The closest crags are located within 2 km of the wind farm site, above Lough Finn on the north-western slopes of Aghla Mountain and while there was eagle activity recorded in this area no breeding site was located. Other potentially suitable crags occur above Lough Ea and Lough Muck just beyond the 2 km turbine buffer; however, it is considered unlikely that these relatively unsecure/lower altitude locations would be occupied given the species propensity to select more isolated locations (Evan *et al.*, 2010[93], Katzner *et al.*, 2020[94] and Snow & Perrins, 1998).

10.(ii).159 Breeding eagle surveys covering the hinterland around the proposed wind farm site in 2019 and 2020 did not locate any nest site within the 6 km turbine buffer; however, there was a profusion of territorial flight displays detected over numerous hills within the survey area by both golden eagles and white-tailed eagles. As noted for white-tailed eagles, this activity was thought to be in part associated with birds prospecting in the wider area; but also involved established pairs delineating territorial boundaries, i.e. aggressive/territorial displaying behaviour. For example, one notable observation of a golden eagle territorial display flight appeared to be elicited by two white-tailed eagles displaying over Aghla Mountain to the NW of the wind farm site, and this was followed by a golden eagle taking a direct flight from the Blue Stacks to Aghla Mountain and engaging in a purposeful bouncing flight along the southern slopes of Aghla Mountain (above the 500 m extent of the turbine envelope).

10.(ii).160 **Figures 5** to **Figure 10** and **Table 5** in **Appendix 3** provide data collected during VP watches and illustrate usage of the wind farm site by golden eagles. Information collected during wider area eagle surveys is displayed in **Appendix 5**.

10.(ii).161 Over the 2-year study golden eagle flight activity through the 500 m turbine buffer was recorded on 16 dates (19 observations) and involved several different birds including adults and sub-adults, including:

- <u>Two observations</u> over the non-breeding season 2018-19

- **Obs. 1** on 01-Nov-2018: 1st, possible 2nd winter bird (40-80m) commuting through site, heads along slopes of Aghla Mountain
- **Obs. 3** on 19-Dec-2018: hunting over open bog north of T2 (*c.* 30m) – age not determined

- <u>One observation</u> during the 2019 breeding season

93 Evans, R.J., Pearce -Higgins, J., Whitfield, D.P., Grant, J.R., MacLennan, A. & Reid, R. (2010). Comparative nest habitat characteristics of sympatric White-tailed *Haliaeetus albicilla* and Golden Eagles *Aquila chrysaetos* in western Scotland. *Bird Study* 57, 473--482.

94 Katzner, T. E., M. N. Kochert, K. Steenhof, C. L. McIntyre, E. H. Craig, & T. A. Miller (2020). Golden Eagle (*Aquila chrysaetos*), version 2.0. In *Birds of the World* (Rodewald, P. G. & Keeney, B. K. Editors). Cornell Lab of Ornithology, Ithaca, NY, USA.

- **Obs. 4** on 10-Apr-2019: hunting through site high over central plantation (*c.* 180m), heads SE over Stracashel River valley towards the Blue Stacks – age not determined

  - Five observations over the non-breeding season 2019-20

- **Obs. 21** on 31-Oct-2019: sub-adult (transmitter pack on back) foraging (10-80m) within NW boundary of 500m turbine buffer, heads along slopes of Aghla Mountain
- **Obs. 22** on 27-Nov-2019: adult perched in site (12:46-13:07), then leaves flying south out of site (0-50-100-200m) flying to Lough Ea, where bird circles for *c.* 8 mins
- **Obs. 29** & **30** on 17-Dec-2020: Perched on ground - stays for *c.* 3 mins, then flies from edge of hill, heads downwards (0-1m), lost from view - presumed to have landed or flew to west
- **Obs. 23** & **24** on 05-Jan-2020: Adult foraging over slopes of Graffy Hill (50-10m at 12:13 for 45 sec. and *c.* 40m at 12:20 for 38 sec.)
- **Obs. 16** on 13-Feb-2020: Adult picked up on hill out of 500m turbine buffer (50m), then flies through site (200m), lost from view against sun, assumed to leave area to south

  - Eleven observations over the 2020 breeding season

- **Obs. 37** on 24-Apr-2020: Adult flying (300+m) north through the site, heads onto slopes of Aghla Mountain
- **Obs. 53** on 28-Apr-2020: Adult flying (50-100m), then glides east through site
- **Obs. 42** on 21-May-2020: Foraging (80-120m), just on edge of 500m turbine buffer
- **Obs. 38** & **39** on 28-May-2020: Adult (male?) picked up after end of watch, circling (50-100m) over slopes above VP4, then glides across valley
- **Obs. 40** on 23-Jun-2020: Adult (male?), circling (40-50m), then drifted west and out of view
- **Obs. 46, 47, 48** & **49** on 13-Aug-2020: Sub-adult (male?), circling/foraging through site (30 to 200m), heads south, leaves site circles over VP3, then heads north through site (150-200m), and lands on scree out of site, at 14:03 (Obs. 65) rises takes short gliding flight over mountain (*c.* 10m) - out of view
- **Obs. 50** on 13-Aug-2020: At 14:09, sub-adult male joined by adult (female?) and fly south through site and over Stracahel River valley
- **Obs. 61** & **62** on 19-Aug-2020: At 14:13 - Adult circling (20-100m) on edge of 500 m turbine buffer and then joined by second adult - one of birds dove steeply twice, appearing like a territorial display flight
- **Obs. 63** & **64** on 19-Aug-2020: At 15:41 - Adult circling (20-50m) on edge of 500 m turbine buffer, lost from view over hill
- **Obs. 55** (**56, 57** & **66** out of site) on 24-Aug-2020: At 12:45 - Adult circling/foraging (25-150m) at the edge of the 500m turbine buffer (joined by 2nd bird)
- **Obs. 60** (**58** & **59** out of site) on 24-Aug-2020: At 12:55 – Two adults flying together (220-50m) just beyond 500m turbine buffer, split and one bird tracked through site dropping (20-5m), possibly lands

10.(ii).162 During VP watches golden eagles were recorded flying within the 500 m turbine buffer for 4,729 seconds, with 3,657 seconds judged to be at heights within the collision risk zone, and the remaining time (1,072 secs.) accounted for by flights above 150 m.

10.(ii).163 Flight activity involved birds foraging/hunting and commuting through the wind farm site. In year one there were significantly fewer observations, which is probably a function of there being more young birds in the area over the second year, as a culmination of successful breeding seasons in 2017, 2018 and 2019. In addition, older established pairs were thought to be more active, possibly extending territorial displays and ranging further, in response to increased levels of white-tailed eagle activity and, as already discussed as more sub-adult birds were beginning to develop pair bonds and prospecting for territories adjacent to establish home ranges.

10.(ii).164 Birds utilising the area appeared to be more attracted to the slopes above Graffy Hill and roughly corresponding to the area between the 300-400 m contours, which coincided with usage of the upper extent of the 500 m turbine buffer. Much of the foraging activity along the southern slopes of Aghla Mountain was considered to be associated with occurrence of carrion, mainly dead sheep which were reported as widely and regularly available. While prey species like red grouse and hare were recorded within the 500 m turbine envelope, the levels of ground cover was observed to be dense on the slopes above the 500 m turbine envelope and it would be anticipated that prey densities would be higher further up the hill where heather cover was denser. Interestingly, some of the eagle foraging activity observed corresponded to the last fence line running SW-NE across the face of the hill, and delineated a line between higher and lower levels of vegetation cover as result of differential grazing regimes. It is possible that eagles are exploiting this edge effect, where potentially higher densities of prey on the upper slope become exposed once they move down the slope into areas with less cover. Another factor possibly attracting eagles to the slopes above the 500 m turbine buffer is the high proportion of exposed rock on the upper slopes of Aghla Mountain, which combined with the steep slopes creating updrafts would generate the thermals that attract soaring birds, like eagles.

10(ii) 4.3.5 MerlinBoCCI: Amber listed

10.(ii).165 One breeding pair was recorded, just beyond the 500 m turbine buffer, south of T2. Different nest sites were occupied in 2019 and 2020, with corvid nests in treelines utilised – see confidential report for locations, request **Appendix 7**, where nest locations and flight activity are shown in relation to site infrastructure. Despite nesting relatively close to an occupied dwelling and a local road, the pair successfully fledged young in both years (3 fledglings in 2019 and 2-3 fledglings in 2020). Site visits in 2021 found that neither of the sites utilised in 2019 or 2021 were occupied. As detailed in the NIS, the 2019 and 2020 nesting locations were 5.2 km and 5.1 km, respectively from the boundary Lough Nillan Bog SPA at its closest point. For the Derryveagh and Glendowan Mountains SPA, the segment encompassing Lough Finn was 3.1 km and 3.3 km for sites occupied in 2019 and 2020, respectively. However, the lough does not provide suitable merlin nesting habitat and the distance for parts of the SPA encompassing suitable merlin nesting are located at 7.1 km and 7.3 km from the 2019 and 2020 nest sites, respectively. On the basis of spatial separation between the breeding site and the SPAs, which are either close to or surpass the maximum territory size of 6 km reported for this species, this pair is considered unlikely to comprise a part of the population of the Lough Nillan Bog SPA and does not form a part of the population within the Derryveagh and Glendowan Mountains SPA.

10.(ii).166 Ground nesting opportunities were assessed as virtually non-existent in the environs of the wind farm site due to the lack of ground cover. The exception being the area around T1, where patches of failed spruce trees within the plantation provide some denser growth of heather amongst the trees. The occurrence of ground nesting merlin in Ireland is significantly lower than the incidence of pairs opting to nest in tree site; and the decline of suitably dense expanses of heath, combined with the increased availability of plantations in upland areas may have driven a shift away from ground nesting (Norriss *et al.*, 2010[95] and Lusby *et al.*, 2017[96]). Although, neighbouring nests can be as close as 500 m apart under optimal habitat conditions; in Ireland nesting density is relatively low and separation distances between breeding pairs is likely to be significantly higher, with Hardley *et al.* (2009)[97] reporting a range of 0.5-4.5 km between nesting territories. No other merlin breeding activity was located within the 2 km turbine buffer; and although nests can prove elusive, it is considered unlikely that there were any additional pairs in the wider area.

10.(ii).167 The majority of flight lines detected were associated with nest site activity and were beyond the 500 m turbine buffer. The higher levels of activity recorded over the second breeding season were a function of an alternative nest site used in 2020 being directly visible from VP2, whereas in 2019 the nest was obscured. Merlins were less frequently encountered during the non-breeding season, although occasionally birds appeared briefly and on one occasion in Sep-2020 a female was observed around the nest site utilised in 2020.

10(ii) 4.3.6 Peregrine BoCCI: Green listed

10.(ii).168 As shown by **Figure 20** in **Appendix 3**, over the two-year study only two peregrine flight lines were recorded within the 500 m turbine buffer during VP watches and flight lines were below the collision risk zone, including:

- 02-Jul-2019 13 sec. at 1 to 2 m
- 13-Feb-2020 18 sec. at 10 to 15 m

10.(ii).169 Birds were occasionally recorded during wider area surveys; however, no breeding sites were identified within the 2 km turbine buffer and the availability of suitable nesting cliff was limited to crags on the northern slopes of Aghla Mountain. These were assessed as having limited

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95 Norriss, D.W., Haran, B., Hennigan, J., McElheron, A., McLaughlin, D.J., Swan, V. & Walsh, A. 2010. Breeding biology of Merlins *Falco columbarius* in Ireland, 1986– 1992. *Irish Birds* 9: 23- 30

96 Lusby, J., Corkery, I., McGuiness, S., Fernández-Bellon, D., Toal, L., Norriss, D., Breen, D., O'Donaill, A., Clarke, D., Irwin, S., Quinn, J.L. & O'Halloran, J. (2017). Breeding ecology and habitat selection of Merlin Falco columbarius in forested landscapes. *Bird Study*, 64:4, 445-454

97 Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. & Thompson, D. (2009). *Raptors: a field guide for surveys and monitoring*. 2nd Ed. Stationery Office, Edinburgh.

inaccessible ledges and considered sub-optimal for this species. Cliffs backing Lough Ea were just beyond the 2 km turbine buffer.

10.(ii).170 Apart from gulls attracted to the mink farm (*c.* 4 km from the wind farm site), potential prey species for peregrine (e.g. golden plover and duck species) were not found to occur in abundance in the environs of the wind farm site, and therefore the area has limited potential to regularly attract hunting peregrines.

10.(ii).171 Based on limited availability of nesting cliff within the 2 km turbine buffer, low densities of potential prey species and low recorded usage of the 500 m turbine buffer, it is objectively considered that the proposed development area is not important for this species, both in terms of breeding and foraging.

10(ii) 4.3.7 Golden plover BoCCI: Red listed

10.(ii).172 No usage of the 500 m turbine buffer was recorded over the two years. There were a small number of observations (n = 3 obs.) of birds recorded or heard along the southern slope of Aghla Mountain, beyond the NW boundary of the 500 m turbine buffer (within 1 km of the wind farm site). The records involving heard birds were from 28-Apr-2020 and 10-May-2020 and were considered to be birds on passage, rather than birds occupying breeding territories. The third record was a flock of 32 birds circling over the southern slopes of Aghla Mountain in Jan-2019, *c.* 700 m north of T2 for a period of approximately 7 mins - see **Obs. 8** in **Appendix 3 – Figure 3**.

10.(ii).173 As described in the section on habitat availability, while the summit of Graffy Hill has small areas of superficially suitable nesting habitat for golden plover, the limited extend, proximity to low level disturbance factors and general lack of nesting cover mean it is highly unlikely that this species would nest at this location. The upper slopes of Aghla Mountain may offer more potential; however, lough surveys of red throated divers, as well as VP4 watches from VP4 did not detect breeding activity adjacent to the wind farm site. The Lough Nillan Bog SPA holds the closest known golden plover breeding sites and are located over c. 10 km away from Graffy Hill.

10.(ii).174 Based on exceptionally low recorded usage of the 500 m turbine buffer, limited availability of good quality breeding habitat within the wind farm site and a distance of > 10 km to the closest known breeding sites, it is objectively considered that the proposed development area is not important for this species, both in terms of breeding and foraging, either in the breeding season, over the winter or on passage.

Red and amber listed species of National nature conservation value

10.(ii).175 Species accounts are provided in the previous section for seven Annex I species recorded that are Red listed, (white-tailed eagle, golden eagle and golden plover) Amber listed (whooper swan, hen harrier and merlin) and Green listed (peregrine). To avoid repetition species accounts for some Red and Amber listed species have been combined into avian assemblages, including wintering waterbirds, breeding waders, gull species and passerines.

10(ii) 4.3.8 Wintering waterbirds

10.(ii).176 Flight line maps and data for waterbirds are provided in **Appendix 3** – see **Figure 1** to **Figure 3** with corresponding tables – see **Table 1** to **Table 3**

10.(ii).177 Recorded usage of the wind farm site by wintering waterbirds of conservation concern was limited to snipe, jack snipe and woodcock. Two green list species, grey heron and mallard were considered as target species, due their classification as waterbirds and were recorded within or directly adjacent to the site. Foraging opportunities in upland streams within the wind farm site were observed to be regularly utilised by a heron out of the breeding season. Small numbers of mallard were occasionally flushed from the Stracashel River during the winter; however, no usage of the 500 m turbine buffer was detected outside of the breeding season.

10.(ii).178 **Whooper swan** (as detailed in the accounts for Annex I species) were found to move through the area in small numbers (flocks of 3 to 23 birds) on spring and autumn passage. Likewise, and to a much lesser extent cormorant, golden plover, redshank, whimbrel (green listed) and curlew were also detected occasionally passing through the area in low numbers; however, none of these species were recorded within the 500 m turbine buffer over the 2-year study period. In summary waterbird records included the following observations:

- For **cormorant** (amber listed – breeding) only a single flight line was recorded in Feb-2020, with 1 bird picked up flying from Graffy Bridge, adjacent to the 500 m turbine buffer and heading SE towards Lough Ea.
- For **grey heron** (green listed) single birds occasionally observed flying into the 500 m turbine buffer to forage along the streams flowing down the slopes from T2/T3. All observations were outside the breeding season for this species and no heronries were identified in the vicinity of Graffy Hill.
- For **mallard** (green listed) birds were rarely recorded within the 500 m turbine buffer and were only observed flying along the edge of the buffer (two flights). Beyond the turbine buffer birds were recorded along the Stracashel River and loughs in the wider area.
- For **golden plover** (red listed – wintering & breeding), as detailed in the species accounts for Annex I species, there were only three records, all involving birds moving along the southern slope of Aghla Mountain, beyond the NW boundary of the 500 m turbine buffer (within 1 km of the wind farm site).

- For **redshank** (red listed – wintering & breeding) there was only a single record, which was a bird or flock heard calling in flight in Sep-2019; detect moving over VP1 – south of the 500 m turbine buffer and was considered to be a passage record.
- For **whimbrel** (green listed) there was only a single record in May-2019, which was a bird or flock heard calling on passage, with bird(s) passing over the slopes of Aghla Mountain, north of the 500 m turbine buffer (within 1 km of the wind farm site).
- For **curlew** (red listed – wintering & breeding) there was only a single record, which was a bird or flock heard calling in Apr-2020, and was considered a passage record. This bird/flock was detected moving over the southern slopes of Aghla Mountain, above the 500 m turbine buffer (within 1 km of the wind farm site).

10.(ii).179 **Snipe** and the occasional **jack snipe** (both previously amber listed, now red and green listed respectively) were recorded in small numbers wintering or on passage within the wind farm site. Based on five winter walkover surveys of the wind farm site, very few snipe were utilising the area during these daytime surveys. Being largely a nocturnal foraging species, it is possible that on nights when milder weather conditions prevail, snipe would move onto Graffy Hill to forage during the winter. However, while there were some suitable wetter areas, habitat availability within the wind farm site was limited in extent, relative to availability in the wider area and the site was considered unlikely to support significant concentration of wintering snipe.

10.(ii).180 Wintering **woodcock** records were generated during site walkovers when birds were flushed from areas adjacent to plantations. The wintering and breeding populations are considered to be different, with the declining breeding population being red listed (see section on breeding waders). The wind farm site, like much of the surrounding area provides cover in plantations for day roosting woodcock adjacent to ample overnight foraging habitats in open bog and grasslands.

10.(ii).181 Wider area winter surveys recorded relatively small numbers of wintering waterbirds (well below thresholds for national importance) and the following species were recorded on the loughs surrounding the wind farm: cormorant, heron, little grebe, whooper swan, mute swan, mallard, teal, golden eye, ring necked duck, tufted duck, coot and moorhen. These populations, the swans in particular, were considered beyond the zone of influence of the proposed development, as they were recorded on loughs > 3 km from closest turbines and there were no regular flight lines between roosts and foraging areas detected through the wind farm site. Lough Shivinagh and Lough Nambraddan, located *c.* 5 km and *c.* 4 km from the development, respectively, were wetland sites identified as being regularly utilised by small flocks of whooper swans (< 30 birds). There are several loughs closer the wind farm site, within *c.* 2 km (e.g. Lough Ea and Lough Muck), however much lower water bird usage was recorded on these loughs, often with no birds recorded.

10(ii) 4.3.9 Red grouse BoCCI: Red listed

10.(ii).182 Flight records collected during VP watches are typically associated with flushed birds or birds recorded beyond the 500 m turbine buffer. All observed flight heights were lower than 10 m.

10.(ii).183 Based on site walkovers and observations during VP watches (calling males), it is estimated that the southern slopes of Aghla Mountain, above the wind farm site supports 3-4 breeding territories. These territories extend down the slope into the NW boundary of the 500 m turbine buffer – see **Appendix 4 – Figure 1**. While birds or evidence of activity was recorded in the 500 m turbine buffer, there was very limited nesting cover, and it is considered unlikely that red grouse breed on the lower slopes of Graffy Hill, within the turbine buffer. Heather cover is denser on some of the northern slopes of Aghla Mountain, which is likely to result in higher densities of breeding red grouse.

10.(ii).184 Overall, the wind farm site is considered to form an integral part of the foraging range red grouse breeding and wintering on Aghla Mountain.

10(ii) 4.3.10 Sparrowhawk BoCCI: Amber listed (2014-19), now Green listed (2020-26)

10.(ii).185 **Figure 15** and **Table 7** in **Appendix 3** provide data collected during VP watches and illustrate usage of the wind farm site by sparrowhawk.

10.(ii).186 Sparrowhawks were recorded hunting through the area over both the breeding season and non-breeding season, with a total of 757 seconds recorded within the 500 m turbine buffer, of which 386 seconds was determined to be at collision risk height. Based on observed flight activity within the 500 m turbine buffer, the collision risk (weighted and applying avoidance rate) was predicted to be low, 0.11 collisions over 25 years. However, the CRM acknowledges the relatively small size and evasive flight behaviour of sparrowhawks could result in flight times being underestimated due to lower detection rates. On balance this species tends to fly relatively low (below rotor swept height), especially when hunting; however, display flights and when commuting long distances results in flight time within the collision risk zone.

10.(ii).187 One breeding territory was identified within the 500 m turbine buffer, and a pair of sparrowhawks nested in conifer plantation within the northern extent of the buffer, in the vicinity of the proposed location for T1. The occurrence of plantations within the predominately open landscape surrounding the wind farm site offers lots of suitable patches of foraging and nesting habitat for this species. Another possible breeding site was identified in the plantation *c*. 900 m north-west of T8. No other breeding sites were identified within the wider area; however, given the orientation of the 2 km turbine buffer in relation to the habitat and landscape features available, it was considered possible that area could be within the home range of one more breeding pair.

10.(ii).188 Overall, the wind farm site was considered to encompass the breeding territory of one breeding pair of sparrowhawk and is probably within the breeding season foraging range with one possibly two additional pairs. Commercial coniferous plantations impinging on upland habitats within the wind farm site facilitates the occurrence of this species in the area.

10(ii) 4.3.11 Kestrel BoCCI: Amber listed (2014-19), now Red listed (2020-26)

10.(ii).189 **Figure 16** and **Figure 17** and **Table 8** in **Appendix 3** provide data collected during VP watches and illustrate usage of the wind farm site by kestrel.

10.(ii).190 Kestrel were regularly recorded foraging through the 500 m turbine buffer, with the south half (T5 to T8) emerging as most heavily utilised area. Flight activity was notably higher in the second year when a pair attempted to breed in a cliffy ravine *c.* 1 km WNW of T7; however, this breeding attempt appeared to fail early in the season, possibly due to nest competition from ravens that were also observed exhibiting breeding behaviour in the ravine.

10.(ii).191 Kestrels typically nest along ledges on cliffs and buildings, but can also utilise the nests of other birds, especially corvid nests in trees. Wider area surveys only found one pair nesting within the 2 km turbine buffer, however in year one an alternative nest location was in use, which was suspected of being located somewhere to the north west of T1. The exact location was not determined and based on the lack of records of juvenile birds it is thought that the breeding attempt was unsuccessful in year one as well. Most of the plantation within the 500 m turbine buffer would be considered relatively young and probably unlikely to be utilised by hooded crows or ravens, which often provide the nests utilised by kestrels. There were some trees noted around T4 that were considered to have some potential. In addition to nest site competition with host species such as corvids, there also potential competition for nests with merlin.

10.(ii).192 Overall flight time within the 500 m turbine buffer was 3,811 seconds, with 3,014 seconds recorded at heights within the rotor swept area; of which 706 seconds (6 observations) were attributed to year one, with year two generating significantly higher flight activity and registered 2,308 seconds (16 observations). Within the wind farm site, the mosaic of different habitat creates lots of edge effects which can be exploited by foraging kestrels.

10(ii) 4.3.12 Breeding waders

10.(ii).193 **Snipe** (BoCCI 2014-19: Amber listed – breeding and wintering, now Red listed) was the only species of wader found breeding within the ZoI of the wind farm site. Most of the flight activity recorded within the 500 m turbine buffer was associated with displaying (drumming) snipe over the slope above T5, T6, T7 and this area supported at least one breeding territory. The only other area within the buffer where breeding behaviour was detected, was in the bog/wet grassland directly north of VP3. Breeding densities in the general area appeared relatively low, however were likely to be representative of the sub-optimal habitat availability (lack of significant wet flushes) relative to the wider area. In addition, both survey years were notably dry, especially over the spring which may have limited suitability of some areas and dampened breeding activity. Beyond the buffer, breeding was recorded from the bog around VP1. Flight activity recorded by snipe during VP watches is provided in **Appendix 3** – see **Figure 2** and **Table 2**. **Appendix 4** provides maps illustrating data on snipe distribution collected during walkover surveys, with VP watch data overlain - **Figure 2** and **Figure 3** for non-breeding season and breeding season respectively.

10.(ii).194 Woodcock (BoCCI: Red listed – breeding) were not recorded breeding; and although, the site was assessed as potentially suitable given the occurrence of commercial forestry plantations, this is a relatively recent development (last *c*. 30 years). Given the historical lack of woodland cover on the upland parts of Graffy Hill (above the lower slopes adjacent to the Stracashel River) it is considered unlikely that woodcock would have traditionally bred in the area. Regardless of historical breeding status, it is considered that woodcock no longer breed in the vicinity of the wind farm site and in Ireland this species appears to be undergoing an eastward range contraction in its breeding distribution.

10.(ii).195 Over the two-year study observations of other waders were limited to birds detected on passage, including the very occasional individual/flocks of golden plover, redshank, whimbrel and curlew – see accounts under winter waterbirds - **Section 10(ii) 4.3.8**. Of these species curlew would have historically bred in the area, and while there is potential breeding habitat in the environs of the wind farm site for this species, especially along stretches of the Stracashel River, the relatively heavy grazing regimes across Graffy Hill has resulted in the limited availability of nesting cover. There are no recent breeding records within 10 km of the wind farm site, and interestingly the EIS for the original planning application did record a curlew on Lough Ea in July 2009; however, there was no note on breeding status.

10.(ii).196 As described in the section on habitat availability (**Section 10(ii) 4.1.2**), while the summit of Graffy Hill has small areas of superficially suitable nesting habitat for golden plover and potentially dunlin, the limited extent, proximity to low level disturbance factors and general lack of nesting cover mean it is highly unlikely that this species would nest at this location. The upper slopes of Aghla Mountain may offer more potential; however, lough surveys did not detect breeding activity in the immediate vicinity of the site (800 m turbine buffer, which is generally considered as the ZoI for disturbance). The Lough Nillan Bog SPA holds the closest known golden plover breeding sites and are located over *c*. 10 km away from Graffy Hill.

10(ii) 4.3.13 Gull species

10.(ii).197 **Table 4** and **Figure 4** in **Appendix 3** provide data collected during VP watches and illustrate usage of the wind farm site by the four species of gull recorded.

10.(ii).198 Three species of gulls were regularly recorded in the environs of the wind farm site including:

- herring gulls — BoCCI 2014-2019: Red listed – breeding population downgraded to Amber list by BoCCI 2020-2026
- lesser black-backed gulls — BoCCI: Amber listed – breeding population remains Amber listed on BoCCI 2020-2026
- great black-backed gulls — BoCCI: Amber listed – breeding population downgraded to Green list by BoCCI 2020-2026

10.(ii).199 A fourth gull species **black-headed gull** (BoCCI 2014-2019: Red listed, downgraded to Amber lit by BoCCI 2020-2026) was recorded once commuting though the turbine envelope (27-Mar-2019 at *c*. 20 m for 124 secs.). There is no suitable nesting habitat for this species within the 500 m turbine buffer or immediate environs, and the closest known breeding colonies are relatively distant being located at Inch Island (Lough Swilly), on Arranmore and Tory Island (Mitchell *et al*., 2004[98] and Cummins *et al*., 2019[99]). Based on very low recorded usage of the 500 m turbine buffer and lack of breeding habitat in the environs, it is objectively considered that the proposed development area is not important for black-headed gull.

10.(ii).200 For all the gull species recorded there was no availability of suitable breeding habitat in the environs of the wind farm site, which typically includes islands on loughs at locations away for the coast and there are no known gull breeding colonies/nesting sites within 20 km of Graffy Hill (Mitchell *et al*., 2004 and Cummins *et al*., 2019).

10.(ii).201 The occurrence of *Larus* gulls within the 500 m turbine buffer was found to be associated with flocks predominately foraging and roosting at the mink farm down the valley, *c*. 4 km to the WSW of the wind farm site (T8). Sporadically, flocks of gull (herring gulls in particular) were observed entering the 500 m turbine buffer, circle over the SW corner and then return south-west, back towards the mink farm. This concentration in gull flight activity is clearly illustrated in **Appendix 3 – Figure 4**.

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

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

10.(ii).202 The mink farm is currently under threat of closure, due to EU wide phasing out of fur-farming and more recently due to proposed mink culls, as a Covid-19 control measure; which if realised, will remove this food resource and result in less gulls being attracted into the area.

10.(ii).203 **Great black-backed gulls** were the most regularly recorded gull species actually commuting through the turbine envelope; in small numbers (1 or 2 birds) and there was also a record of one bird foraging on carrion in a ditch within the wind farm site. Flight lines through the wind farm site were only recorded in the second study year, and this appears to be linked to a slight increase in sporadic gull activity within the wind farm site over this period. The heights for majority of flight lines through the turbine envelope (n = 6 obs.) were judged to be within the collision risk zone and aggregated amounted to 1,018 flight seconds.

10.(ii).204 **Lesser black-backed gulls** in small numbers (1 to 4 birds) were recorded flying/commuting through the 500 m turbine buffer. In spring this species is observed foraging widely inland, often exploits foraging (scavenging) opportunities associated with lambing and will also forage in fields where slurry has been spread or silage has been recently harvested. Although some lesser black-backs (mainly sub-adults) over-winter in Ireland, most birds leave the country, explaining the lack of records out of the breeding season – see observation dates in **Appendix 3 – Table 4**. The heights for majority of flight lines through the turbine envelope (n = 10 obs.) were judged to be within the collision risk zone and aggregated amounted to 2,402 flight seconds.

10.(ii).205 **Herring gulls** were observed to be the most numerous gull species recorded in the environs of the wind farm site, with a high proportion of sub-adult birds typically noted in flocks. Although, a relatively high combined flight time within the 500 m turbine buffer and at rotor swept height was recorded (19,395 flight secs.), this was driven by a single large flock (150 birds). The occurrence of herring gulls within the wind farm site was limited to four observation over the two years, with an additional observation of mixed flock of gulls (60 birds) judged to be mostly immature herring gulls.

10.(ii).206 Based on relatively low recorded usage of the 500 m turbine buffer and lack of breeding sites in the vicinity of the wind farm site, it is objectively considered that the proposed development area is of limited importance for great black-backed gulls, lesser black-backed gulls and herring gulls.

10(ii) 4.3.14 Red and amber listed breeding passerines

10.(ii).207 **Figure 4** to **Figure 8** in **Appendix 4** provide composite maps illustrating data collected during walkover and illustrate usage of the wind farm site by red and amber listed passerines.

10.(ii).208 There were three red listed breeding species including whinchat, grey wagtail and meadow pipits recorded within the wind farm site. A fourth species – ring ouzel was considered a non-breeding record.

10.(ii).209 **Whinchat** is considered a rare breeding species in Ireland that breeds in lowland wet grassland or upland heaths. The size of the Irish whinchat population is unknown, and Colhoun & Cummins (2013) provide an estimate of 200 pairs, which is a marked decline from the range of 1,250-2500 pairs reported in Gibbons *et al.* (1993). There were two breeding territories that were identified within the 500 m turbine buffer, both to the south of T8. This breeding location is certainly of regional significance and the 2 pairs are likely to constitute > 1% of the regional population. These pairs were utilising the wet grassland, with occasional patches of scrub that occurs on the northern bank of the Stracashel River. This area, to the east of Graffy Bridge has received limited agricultural improvement in recent years and the grazing regime appeared to be relatively intermittent to light, resulting in the denser cover of ground vegetation favoured by this species.

10.(ii).210 **Grey wagtails** were consistently recorded during the breeding season utilising the main stream flowing down the hill through the northern part of the 500 m turbine buffer, with a family group recorded in Jun-2020 confirming breeding. Upland eroding streams provide foraging opportunities for this species within the wind farm site and short sections of the main stream provide suitable nesting habitat in relatively steep sided rocky banks, otherwise availability of nest sites were assessed as limited and probably limits usage of the area to single pair. There are more opportunities for pairs to hold territories along the Stracashel and Stranagoppoge Rivers. Although red listed, grey wagtails are relatively widespread and common on waterways and other waterbodies across Ireland. Severe winters during the last Bird Atlas (Balmer *et al.*, 2013)[100] were thought to contribute to the observed population decline in this species, which although still registering declines appears to be stabilising (Crowe *et al.* 2014[101] and Lewis *et al.*, 2019a)[102]. In relation to development projects, grey wagtails regularly utilise holes/cervices in man-made nest sites, including bridges and rock armouring around culverts.

10.(ii).211 **Meadow pipit** were the most commonly recorded breeding bird species within the 500 m turbine buffer. This ground nesting species utilises a range of heath, bog and unimproved grassland, including rank vegetation in forestry rides. Birds tend to leave the upland slopes over the autumn although small numbers were recorded throughout the winter. The most recent population estimates give a figure of 1,007,407–1,726,880 birds, and as for grey wagtail, meadow pipit number registered a crash, thought to be linked with consecutive cold winters in 2009/10 and 2010/11, with

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

101 Crowe, O., Musgrove, A.J. & O'Halloran, J. (2014). Generating population estimates for common and widespread breeding birds in Ireland. *Bird Study* 61(1): 82-92

102 Lewis, L. J., Coombes, D., Burke, B., O'Halloran, J., Walsh, A., Tierney, T. D. & Cummins, S. (2019a) Countryside Bird Survey: Status and trends of common and widespread breeding birds 1998-2016. *Irish Wildlife Manuals*, No. 115. NPWS, Department of Culture, Heritage and the Gaeltacht, Ireland.

more recent data indicating the species is staging a recovery. (Lewis *et al*., 2019a). These declines contributed to meadow pipit being assigned to the Red list.

10.(ii).212 **Ring ouzel** was only recorded once and this was considered an incidental record of a bird on passage. A single bird was observed from VP1 in Oct-2018, well south of the 500 m turbine buffer. The wind farm site was assessed as not offering suitable nesting cover for this species. The closest mountainous terrain, with scree and dense heather, typically favoured by this rare breeding species in Co. Donegal, were up on the upper slopes of Aghla Mountain and were considered beyond the zone of influence for the wind farm site. Based on no recorded usage of the 500 m turbine buffer and lack of breeding sites in the close vicinity to the wind farm site, it is objectively considered that the proposed development area is of limited importance for ring ouzel.

10.(ii).213 The **assemblage of breeding passerines** (refer to **Table 6** for full list) occurring within the wind farm site are associated with either open upland habitats or coniferous commercial plantations, with the lower lying agricultural grasslands and river valley, as well as the nearby mountain ranges exerting an influence on the avi-fauna at this location. The following habitat types supported a range of amber listed breeding passerines, including

- Open areas of blanket bog/unimproved acid grassland provide suitable habitat for ground nesting amber listed species, notably skylark and where small patches of scrub occur stonechat (downgraded to Green list by BoCCI 2020-2026).
- Conifer plantations with associated scrub cover are suitable for a range of species including amber listed breeding goldcrest, with mistle thrush and robin now both downgraded to Green list by BoCCI 2020-2026.
- There were several small patches of more mature, open broadleaf/conifer woodland, often associated with old farmsteads that were favoured by spotted flycatchers.
- Several abandoned houses/sheds within the wind farm site supported breeding swallows and starlings, the closest being the cottage at T4.
- Although wheatears were recorded within or adjacent to the wind farm site during the breeding season, the rocky crevices favoured by this species were not abundant at this location and breeding was at low densities, with some of the early season records considered to be birds moving through the area.

10.(ii).214 There were nine species of BoCCI (2014-2019) Amber listed breeding passerines that were recorded breeding within the wind farm site, including: goldcrest, mistle thrush↓, robin↓, skylark, spotted flycatcher, starling, stonechat↓, swallow and wheatear. BoCCI (2020-2026) re-assessment resulted three species being downgraded to the Green list, including mistle thrush, robin and stonechat. Willow warbler were upgraded from the Green to Amber list.

10.(ii).215 Two non-breeding BoCCI (2014-2019) Amber listed species were recorded foraging within wind farm site including house martin, which likely to be breeding adjacent to the site and swifts that were only recorded once (Note: Swifts are not passerines, however are included here, due to superficial similarity to hirundines – swallows and martins. Based on BoCCI 2020-2026 swifts are now Red listed).

<u>Other secondary target species – Green listed species</u>

10(ii) 4.3.15 Buzzard

10.(ii).216 **Figure 18** and **Figure 19** and **Table 9** in **Appendix 3** provide data collected during VP watches and illustrate usage of the wind farm site by buzzards.

10.(ii).217 Buzzards were the most commonly recorded target species over the baseline study, with 33 observations recorded within the 500 m turbine buffer during VP watches and generated the highest number of flight seconds (8,011 seconds), behind herring gulls which was boosted by a flight with 150 birds. Buzzards, typically single birds were recorded regularly foraging or commuting through the wind farm site. Interestingly, flight time within the turbine envelope over the second year was significantly lower compared to the first year, and there is speculation as to whether this reduction might have been driven by more eagle flight activity in the area over year 2.

10.(ii).218 No breeding sites were located within the 500 m turbine buffer. There was some potentially suitable nesting habitat noted in more mature stands of trees within the wind farm site. No breeding sites were confirmed within the 2 km turbine buffer, with three possible sites identified in plantations adjacent to the site. As conifer plantations along the Stracashel River mature the area will be become increasingly suitable for nesting buzzard.

NOTE: For baseline information on other green listed target species, including grey heron, mallard and whimbrel see species accounts under wintering waterbirds **Section 10(ii) 4.3.8** or species notes in **Table 6**

10(II) 5 ASSESSMENT OF ORNITHOLOGICAL IMPACTS

10.(ii).219 The key ornithological receptors are defined as species occurring within the zone of influence of the proposed development upon which likely significant effects are assessed. The desk-top study and baseline surveys identify key ornithological receptors and allows the scope of the ornithological impact assessment to be defined.

10(ii) 5.1 Identifying key ornithological receptors

11.1.2 The desk-based study and two years of ornithological surveys have identified the following species as key ornithological receptors. Based on the criteria listed in **Table 1** (Percival, 2003) for assessing sensitivity of avian populations the key ornithological receptors are as follows:

- **Very high sensitivity**
  - Merlin – breeding, potentially ecologically linked to populations within the Lough Nillan Bog SPA and Derryveagh and Glendowan Mountains SPA, although separation distance > 5 km between both SPAs and nest sites places this pair beyond zone of influence for this species.

  Note: For other QIs of these two SPAs, (including breeding red-throated diver, peregrine, golden plover and dunlin; and wintering Greenland white-fronted geese) no source-receptor pathways were identified and these species were excluded from further assessment at this level of population sensitivity.
- **High sensitivity**
  - White-tailed eagle – pioneering population
  - Hen harrier – non-breeding, occasional observations - classed high under Percival (2003)
  - Golden eagle – resident population
- **Medium sensitivity**
  - Whooper swan – passage population
  - Red grouse – resident population
  - Populations/individuals listed as Annex I species, occasionally occurring (as non-breeding birds) within and/or adjacent to the wind fam site - peregrine, golden plover
  - Assemblage of Red listed breeding passerines, including meadow pipit, grey wagtail and whinchat

  Note: Breeding woodcock are BoCCI red listed and would be classed as medium sensitivity; however, no breeding birds were recorded; therefore, as the wintering population is not classed as sensitive, woodcock were not carried through into the assessment at this level of population sensitivity.

  Note: A single record of ring ouzel out of the 500 m turbine buffer was considered a non-breeding bird, probably on passage and was not carried through into the assessment at this level of population sensitivity.

- **Low sensitivity**
  - Sparrowhawk – breeding population – moved to *Not sensitive* as now Green listed
  - Kestrel – breeding population – moved to *Medium* sensitivity as now red listed
  - Snipe – wintering & breeding population – moved to *Medium* sensitivity as now red listed
  - Jack snipe – wintering/passage population – moved to *Not sensitive* as now Green listed
  - Assemblage of Amber listed breeding passerines, including: goldcrest, mistle thrush, robin, skylark, spotted flycatcher, starling, stonechat, swallow, wheatear. Willow warbler are now Amber listed. Note: mistle thrush, robin and stonechat are now Green listed and therefore not sensitive
  - Non-breeding small amber listed species included foraging house martin and swift
- **Other species** assessed, included:
  - Non-breeding gulls - Although population sensitivity for breeding gull populations under Percival (2003) would be classed as medium sensitivity (herring gull - BoCCI: red listed - breeding) or low sensitivity (lesser black-backed gull, great black-backed gull – BoCCI: amber listed - breeding); only non-breeding gulls were recorded. As outlined in the baseline, the species making up this population of non-breeding gulls were observed to behave in a relatively similar manner in relation to the proposed wind farm site; and therefore, potential impacts on non-breeding gulls were assessed together. One observation of a single non-breeding black-headed gull was not carried through into the assessment.
  - Buzzard, was included although BoCCI - Green listed, due to relatively high occurrence and inherent collision risk.
  - Woodcock was identified as a key ornithological receptor, although only wintering birds were recorded and it is only the breeding component of the population that is BoCCI Red listed.

10.(ii).220 Other BoCCI - Green listed target species, including heron and mallard were not carried through into the assessment, as site usage was considered low and populations of these species are not considered sensitive to wind farm developments Similarly, cormorant which was recorded once during the winter (beyond 500 m turbine envelope) was not carried through to the assessment stage, as only the breeding population is BoCCI Amber listed and there are no breeding colonies in the vicinity of the proposed wind farm site.

10(ii) 5.2 Interpretation of significance of effects

10.(ii).221 As described in **Section 10(ii) 3.3.4,** Percival (2003) suggests the following in interpretation of significance ratings, based on target species outputs from the significance matrix in **Table 5**, which combines magnitude of effect and nature conservation importance (population sensitivity) to generate the levels of significance associated with potential impacts due to the proposed development.

- **Not significant** is considered *de minimis* or inconsequential

- **Very low significance** and **low significance** should not normally be of concern, though normal design care should be exercised to minimise impacts.
- **Medium significance** represents a potentially significant impact that requires careful individual assessment. Such an impact could warrant planning refusal, but it may be of a scale that can be resolved by revised design or appropriate mitigation.
- **Very high significance** and **high significance** represent a highly significant impact on bird populations and would warrant refusal of a planning proposal.

10(ii) 5.3 Assessment of Potential Effects

10(ii) 5.3.1 The 'Do-Nothing' Impact

10.(ii).222 The proposed development site encompasses upland farmland and commercial coniferous forestry plantation that are currently managed through a combination of extensive grazing regimes and agroforestry practices. If the proposed development does not proceed, the area is considered likely to remain in use for agriculture/forestry purposes.

10(ii) 5.3.2 Construction Phase Impacts

10.(ii).223 The construction phase will result in a certain amount of inevitable impact, largely in the form of habitat alteration and disturbance, to facilitate construction of site access tracks, turbine bases, hardstand areas, sub-station and excavation for cabling to facilitate grid connection. In addition, there is potential for impacts upon ornithological features along the haul route where modifications to areas are required to facilitate the passage of large vehicles and components. Timing of the construction works will have an effect on the level and type of impact, since a number of species are known to nest within and adjacent to the area, including the following red or amber listed species: red grouse, sparrowhawk, merlin, kestrel, snipe, meadow pipit, grey wagtail, robin, goldcrest, skylark, whinchat, stonechat, wheatear, spotted flycatcher, mistle thrush, swallow and starling.

10.(ii).224 Typically, the construction phase for wind farm development is less than 2 years, therefore temporal magnitude of disturbance effects emanating from the construction phase of the project will be *Temporary – short term* (Percival, 2003). Potential impacts during the construction phase encompass both direct impacts and secondary impacts, which are summarised as follows:

- Potential sources of direct impacts during the construction phase
  - Damage or destruction of bird nesting sites located within or directly adjacent to the construction corridor.
- Potential sources of secondary impacts during the construction phase
  - Disturbance from construction activities resulting in avoidance and displacement of foraging and breeding birds.

- Avian species reliant on aquatic habitats, such as kingfisher, dipper, grey wagtail or heron can be impacted by a construction related pollution incident or sedimentation (e.g. accidental spillage of hydrocarbons, cement/concrete entering the water course or a peat slippage).

10.(ii).225 It is noted that vegetation clearance associated with access routes will be at a minimal level and the main habitat loss will be associated with the immediate area around each turbine.

10(ii) 5.3.2.1 Designated sites - Potential construction phase impacts

10.(ii).226 As outlined in **Section 10(ii) 4.1.3**, the Application Site is not within or adjacent to any Special Protection Areas. Designated areas considered as having potential ornithological links with the proposed development included Derryveagh and Glendowan Mountains SPA, Lough Nillan Bog SPA and Sheskinemore Lough SPA. The QI species for these SPAs included: breeding red-throated diver, peregrine, merlin, golden plover and dunlin and wintering Greenland white-fronted geese.

10.(ii).227 Breeding red-throated diver, peregrine, golden plover and dunlin were not recorded as occurring within or adjacent to the Application Site during surveys. Likewise, wintering Greenland white-fronted geese were not recorded as occurring within or adjacent to the Application Site during surveys. For these five species, it is considered there is no ecological link between the Application Site and designated bird populations within the Derryveagh and Glendowan Mountains SPA, Lough Nillan Bog SPA and Sheskinemore Lough SPA; and therefore, no potential for impact by disturbance or displacement during the construction phase.

10.(ii).228 Merlin nested in a location adjacent to the Application Site and in the absence of appropriate mitigation there is potential for construction activities to result in disturbance and/or displacement of this pair during the construction phase of the project. Displacement of this pair during the breeding season, could put pressure on neighbouring pairs in terms of nest site competition, which could adversely affect merlin populations within both neighbouring SPAs. Productivity could also be supressed over the construction period. The likelihood for construction related activities to result in displacement of the resident pair of merlin are discussed in **Section 10(ii) 5.3.2.2**. As discussed in **Section 10(ii) 4.3.5** and illustrated by maps in **Appendix 7**, on the basis of spatial separation between the breeding site and SPAs, which are either close to or surpass the maximum territory size of 6 km reported for this species; the pair associated with the proposed development is considered unlikely to comprise a part of the population of the Lough Nillan Bog SPA and does not form a part of the population within the Derryveagh and Glendowan Mountains SPA.

10.(ii).229 A potential (but distant, c. 77 km) hydrological link was identified between the wind farm site and a downstream designated site; the Lough Foyle SPA, which is a cross border SPA designated for a range of waterbird species. In the absence of appropriate mitigation measures, a construction related pollution incident or sedimentation (e.g. accidental spillage of hydrocarbons, cement/concrete entering the water course or a peat slippage) is considered possibly, but highly unlikely to have potential for significant effects on downstream QIs within the Lough Foyle SPA, given the separation distance between source-receptor pathway and resultant dilution effects and relative sensitivities of the QI birds species.

10(ii) 5.3.2.2 Merlin - Potential construction phase impacts

10.(ii).230 This section is supported by detailed maps in **Appendix 7**, which is a confidential appendix providing potentially sensitive information on merlin breeding activity adjacent to the wind farm site, including flight-lines and nesting locations.

10.(ii).231 While the nest locations utilised during the 2019 and 2020 breeding seasons are beyond the 500 m turbine buffer, based on the current turbine layout, there is potential nesting habitat within the works corridor (trees around T1 and T4); and therefore, if birds shifted nest site during the build there is potential for inappropriately monitored/phased construction works to result in direct disturbance of a merlin nest. The likelihood of this occurring was considered low, as tree nesting merlin rely on taking over the nests of other species, typically corvids; and these were not readily available within the works corridor.

10.(ii).232 There is potential for secondary disturbance to breeding merlin, if either of the nest sites used in 2019 and 2020 were re-occupied during the construction phase of the project. While merlins are known to utilise a selection of different nest locations between years, it likely that the 2019/2020 sites will be viable for a number of years. As tree nesting pairs require the use of other bird's nests and unless nests are periodically maintained by the host species, over time they will disintegrate and become unsuitable.

10.(ii).233 The 2019 and 2020 nests are located 45 m and 95 m, respectively from the local road along which the site will be accessed and where trenches for cabling will be excavated. Both nesting locations are within 200 m of the heavy civil works that will be required in constructing the access track off the main road to T1 and T2. The access track off the main road to T4/T3 where heavy civil construction works will be required is within 270 m and 390 m of the 2019 and 2020 nesting locations, respectively. Overall, the nest site occupied in 2019 will be marginally closer to the works corridor, which arcs around this nest location from T1 to T4 within distances of 200-730 m.

10.(ii).234 All be it a relatively quiet area in terms of traffic/human activity, the fact this pair opted to nest in close proximity to a local road (45-95 m) and within 45 m (2019) to 180 m (2020) of an occupied dwelling in both years, suggests they are tolerant/habituated to a certain level of human activity.

Ruddock & Whitfield (2007)[103] provide a review of exclusion zone buffers around nest sites for this species, designed to limit the impacts of human disturbance, which suggests that disturbance effects from construction are unlikely to extend beyond 400 m, with 500 m given as the highest estimate.

10.(ii).235 Construction of access tracks and bases for turbines are understood to represent the proposed construction related activities that will generate the highest levels of noise pollution and the most on-site human activity likely to result in potential disturbance events for breeding merlin. In the original project design (as surveyed) T1, T2 and T3 were closer to the breeding sites, and the location of the 2019 nest (the closest nesting option) would have been *c.* 400 m from works for the construction of the turbine-base at T2 and within *c.* 500 m of works for the turbine-base at T1, with T3 falling just beyond 500 m. In the finalised layout, construction works for turbine bases will all fall beyond the 500 m turbine buffer, including T1 (*c.* 600/590 m), T2 (*c.* 570/710 m), T3 (*c.* 600/770 m), T4 (*c.* 830/950 m) - measurements given are for both nest locations to works area around turbine base, i.e. add 80 m for distance to base of tower.

10.(ii).236 If birds occupy either nest location during the build there is potential for inappropriately monitored/phased construction works to result in disturbance to breeding merlin that may lead to reduced productivity and possible displacement during the construction phase of the project.

10.(ii).237 Due to potential ecological links to populations within two SPAs, breeding merlin at the wind farm site were classed as having *Very High* sensitivity. It is acknowledged that there is a high degree of uncertainty in estimating population sizes for merlin, and expert opinion provides population estimates ranging from 250 to 400 pairs for the Republic of Ireland (BWI, 2010)[104]. The combined population of the SPAs is reported as 11 to 16 pairs, based on site synopsis for the Derryveagh and Glendowan Mountains SPA (6 to 11 pairs)[105] and Loug Nillan Bog SPA (5 pairs)[106].

10.(ii).238 Based on **Table 3** (Percival, 2003), the potential magnitude of effects on the merlin population within local SPAs, due to a potential reduction in productivity caused by construction related disturbance or displacement of a single pair was assessed as *moderate* (a partial reduction in productivity due to displacement or disturbance). However, given the *temporary – short term* nature of wind farm construction (typically 12 to 18 months, i.e. only affecting 1 possibly 2

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103 Ruddock, M. & Whitfield, D. (2007). *A review of disturbance distances in selected bird species.* A report from Natural Research (Projects) Ltd to Scottish Natural Heritage.

104 BirdWatch Ireland (2010). *Action Plan for Upland Birds in Ireland 2011-2020.* BirdWatch Ireland's Group Action Plan for Irish Birds. BWI Kilcoole, Co. Wicklow

105 NWPS Site Synopsis (2014) Derryveagh & Glendowan Mountains SPA: https://www.npws.ie/protected-sites/spa/004039

106 NWPS Site Synopsis (2010) Lough Nillan Bog SPA: https://www.npws.ie/protected-sites/spa/004110

breeding seasons) the order of magnitude was reduced to *Low*. The significance matrix in **Table 5**, for a species with *Very High* sensitivity due to potential ecological links to populations within SPAs and potential impacts with *Low* magnitude of effects returns an impact of *Medium significance* for direct/indirect disturbance on breeding merlin.

10.(ii).239 The works corridor for the wind farm site is considered to be within the foraging range of the merlin breeding area; therefore, it can be assumed that there will be a level of disturbance during construction works that may result in the displacement of foraging bird to another area. However, the size of the works corridor relative to foraging habitat available in the wider area means that any potential displacement effects on foraging birds caused by disturbance during construction is considered to be *negligible*; therefore, in view of the *temporary – short term* nature of the proposed construction works, potential secondary impacts on foraging merlin are considered as *not significant*.

10(ii) 5.3.2.3 White-tailed eagle - Potential construction phase impacts

10.(ii).240 No breeding sites were located within the 6 km turbine buffer; however, high levels of display behaviour were observed in the wider area, which was considered to be birds pairing up, prospecting sites and testing the boundaries of potential breeding season home ranges. Based on these behavioural observations, it is considered likely that pairs will establish breeding territories in the area surrounding the wind farm site in the coming years. Predicting occupation of potentially suitable nesting location is problematic for this species, as they utilise a wide range of crag and tree sites, and there may be also be inter-specific competition with golden eagles for nest sites and territories influencing site selection; however, Evans *et al.* (2010)[107] suggest these two species exhibit resource partitioning with white-tailed eagles tending to occupy sites at lower altitudes. As outlined in the baseline study, availability of suitably secure nesting crags/tree sites was assessed as limited within 1 km of the wind farm site. Therefore, it is considered that there is no risk of direct nest disturbance during the construction phase, as there is no potential nesting habitat within or directly adjacent to the proposed work corridor.

10.(ii).241 Percival (2003) pre-dates the re-introduction of white-tailed eagles into Ireland, which commenced in 2007; and as such, does not feature in **Table 1**. As for golden eagle, it is considered that white-tailed eagles are a species exhibiting ecological sensitivity to wind farm developments, due to a small (pioneering population); therefore, it is appropriate that the Irish population should be classed as having *High* sensitivity.

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107 Evans R.J., Pearce-Higgins J., Whitfield D.P., Grant J.R., MacLennan A. & Reid R. (2010). Comparative nest habitat characteristics of sympatric White-tailed *Haliaeetus albicilla* and Golden Eagles *Aquila chrysaetos* in western Scotland. *Bird Study*, 57:4, 473-482

10.(ii).242 Potential white-tailed eagle nesting habitat in relation to the wind farm sites was determined to be beyond any exclusion zones (mainly for forestry related activities), as reviewed in Ruddock & Whitfield (2007)[108], which suggests that buffers ranging from < 1 km to 300 m from nest sites are sufficient to avoid disturbance to breeding birds. In view of the potential for white-tailed eagles to occupy nests in the area > 2 km from the wind farm site and taking account of the species' *high* population sensitivity, it is considered that the potential impact of construction disturbance on any future white-tailed eagle breeding sites would be of *negligible* magnitude and therefore would not be *not significant*.

10.(ii).243 In terms of disturbance/displacement of white-tailed eagles utilising areas within or surrounding the proposed works corridor during the construction phase of the project; over the baseline study white-tailed eagle flight activity through the 500 m turbine buffer was recorded on seven dates (eight observations) and would be classed as relatively low, with a high proportion of the observed flights typically by birds commuting through the area, rather than birds actively foraging or hunting. Therefore, disturbance resulting from construction activities may have a localised effect, displacing individuals moving though the area on a given day. In consideration of, the relatively discreet nature of the proposed construction works within the wider landscape, the availability of alternative foraging areas within the wider area and because the intermittent level of recorded usage of the area clearly demonstrates that white-tailed eagles are not exclusively or even moderately reliant on the proposed development site, as well as the *temporary – short term* nature of the proposed construction works, potential secondary impacts on foraging white-tailed eagles are considered of *negligible* magnitude and therefore *not significant*.

10(ii) 5.3.2.4 Hen harrier – Potential construction phase impacts

10.(ii).244 Hen harriers were only occasionally recorded foraging through the wind farm site on four dates out of the breeding season. There were no breeding sites located with the 2-km turbine buffer and based on National hen harrier surveys, the closest known breeding sites are > 5 km away, towards Ballybofey. As evidenced by the lack of breeding season records during the baseline study, the current distribution of breeding hen harriers is beyond the core breeding season foraging range of 2 km considered in SNH (2016)[109]. Therefore, as reviewed in Ruddock & Whitfield (2007)[110], hen harrier breeding activity in relation to the wind farm site is well beyond the maximum '*safe working distance buffer*' of 1 km from any known breeding sites. Based on the lack of historical occupancy

108 Ruddock, M. & Whitfield, D. (2007). *A review of disturbance distances in selected bird species*. A report from Natural Research (Projects) Ltd to Scottish Natural Heritage.

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

110 Ruddock, M. & Whitfield, D. (2007). *A review of disturbance distances in selected bird species*. A report from Natural Research (Projects) Ltd to Scottish Natural Heritage.

and sub-optimal habitat availability (conifer plantations), the possibility of hen harriers populating new breeding territories within 1-2 km of the works corridor was considered low. Therefore, taking account of the species' *high* population sensitivity (Percival, 2003), and based on the species' current distribution it is considered that the potential impact of construction disturbance on breeding hen harriers is *not significant*. However, it is important to note that depending on ongoing forestry operations in the area, suitability could change over the next 5-10 years, leading to areas of clearfell/ second rotation becoming occupied prior to or during construction; highlighting the importance of monitoring during the construction phase of the project.

10.(ii).245 During the baseline study the wind farm site emerged as a sporadically utilised area within the non-breeding season range of hen harriers. No consistently used winter communal roosts were detected in the environs of the works corridor, although a bird was suspected of opportunistically roosting at the edge of a forestry plantation within the wind farm site over one night. Therefore, it can be assumed that there is potential for a level of one-off disturbance events during construction works that may result in the displacement of intermittently foraging birds to another area. However, the size of the works corridor relative to foraging habitat available in the wider area, combined with low bird usage, means that any potential displacement effects on foraging birds caused by disturbance during construction is considered to be *negligible*. Therefore, taking account of the species' *high* population sensitivity (Percival, 2003), it is considered that the potential impact of construction disturbance on foraging hen harriers is of *negligible* magnitude and therefore *not significant*.

10(ii) 5.3.2.5 Golden eagle - Potential construction phase impacts

10.(ii).246 As outlined in the section covering the results of the baseline study, availability of suitable nesting sites was assessed as limited within 1-2 km of the wind farm site. Therefore, it is considered that there is no risk of direct nest disturbance during the construction phase, as there is no potential nesting habitat within or directly adjacent to the proposed work corridor.

10.(ii).247 The published stand-off distances between human activity and golden eagle nest sites range from 750 m to 1.5 km (as reviewed in Ruddock & Whitfield, 2007)[111]. Therefore, considering that no breeding activity was recorded within the 6 km turbine buffer and that the probability of future occupancy within 1.5 km of the works corridor was determined to be unlikely, there will be no secondary impacts to golden eagle breeding sites resulting from construction works.

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111 Ruddock, M. & Whitfield, D. (2007). *A review of disturbance distances in selected bird species*. A report from Natural Research (Projects) Ltd to Scottish Natural Heritage.

10.(ii).248 Given the increased level of site usage recorded over the second year of the baseline study, it is considered that construction activities may have a localised effect, displacing individuals foraging though the area. However in consideration of the relatively discreet nature of the proposed construction works within the wider landscape, the availability of alternative foraging areas within the wider area and because the intermittent level of recorded usage of the area clearly demonstrates that golden eagles are not exclusively reliant on the proposed development site, as well as the temporary – short term nature of the proposed construction works, potential secondary impacts on foraging golden eagles are considered of *negligible* magnitude and therefore *not significant.*

10(ii) 5.3.2.6 Whooper swans – Potential construction phase impacts

10.(ii).249 Over autumn-2018, spring-2019 and autumn-2019 (i.e. acknowledging limitation to survey effort in spring-2020) whooper swans were only recorded flying through the wind farm site on passage, on a limited number of occasions (4 observations) and in relatively small numbers (3 to 23 birds). There were no roost sites or foraging areas with 2 km of the wind farm site. Taking account of the species' *medium* population sensitivity and the fact that recorded site usage was limited to a very low level of passage flights, it is considered that the potential impact of construction disturbance on whooper swan is *not significant.*

10(ii) 5.3.2.7 Red grouse – Potential construction phase impacts

10.(ii).250 Overall, the wind farm site is considered to form an integral part of the foraging range of red grouse breeding and wintering on Aghla Mountain. Based on habitat availability there is limited nesting cover for red grouse within the 500 m turbine buffer and while territories extend into the wind farm site from the upper slopes of Aglha Mountain, it is considered that there are no nest sites or nesting potential within the proposed works corridor. Therefore, it is considered that there is no risk of direct nest disturbance during the construction phase of the project.

10.(ii).251 Pearce-Higgins *et al.*, (2012)[112] found that wind farm construction initially resulted in significant reduction in densities of red grouse; however, this effect was short lived and numbers had recovered by year 1 post-construction. A *zone of sensitivity* of 500 m for red grouse is given by McGuiness *et al.*, (2015)[113] and construction activities are likely to result in temporary – short term displacement effects on up to four territorial pairs that utilise the 500 m turbine buffer as foraging habitat. It is not anticipated that breeding densities will be reduced, rather that foraging activity may become restricted to an area beyond the 500 m turbine buffer. Due to the short-term nature of

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112 Pearce-Higgins, J.W., Stephen, L., Douse, A. & Langston, R.H.W. (2012). Greater impacts of wind farms on bird populations during construction than subsequent operation: results of a multi-site and multi-species analysis. *Journal of Applied Ecology*, 49, 386–394

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

the works, the magnitude of the effect was assessed as *negligible*; however, given the sedentary nature of red grouse populations this could be heighted to *low*. Overall considering the *medium* sensitivity of the species and the temporary – short term duration of construction activity, potential secondary impacts on foraging red grouse are therefore considered *not significant*.

10(ii) 5.3.2.8 Peregrine – Potential construction phase impacts

10.(ii).252 As outlined in **Section 4310(ii) 4.1.3.4** & **Section 10(ii) 4.3.6** covering the findings of the baseline study, there is limited availability of nesting cliffs within the 2 km turbine buffer, low densities of potential prey species and low recorded usage of the 500 m turbine buffer. No ecological link was established to the SPAs within the potential zone of influence of the proposed development; therefore, as an Annex I and BoCCI Green listed species, the sensitivity of the peregrine population at this location was assessed as *medium*. It is objectively considered that any potential displacement effects on foraging birds caused by disturbance during construction will be of *negligible* magnitude and therefore *not significant*.

10(ii) 5.3.2.9 Golden plover – Potential construction phase impacts

10.(ii).253 As outlined in **Section 10(ii) 4.1.3.3** & **Section 10(ii) 4.3.7** covering the findings of the baseline study, there was no bird usage recorded within the 500 m turbine buffer (three observations of birds on passage were recorded beyond the buffer), limited extent/availability of good quality breeding habitat within the wind farm site and a distance of > 10 km to the closest known breeding sites. No ecological link was established to the SPAs within the potential zone of influence of the proposed development; therefore, as an Annex I and BoCCI Red listed species, the sensitivity of the golden plover at this location was assessed as *medium*. It is objectively considered that any potential displacement effects to birds on passage caused by disturbance during construction will be of *negligible* magnitude and therefore *not significant*.

10(ii) 5.3.2.10 Red listed breeding passerines – Potential construction phase impacts

10.(ii).254 Breeding Red listed passerines recorded within the 500 m turbine buffer included whinchat, grey wagtail and meadow pipit

10.(ii).255 Two pairs of **whinchat** were recorded breeding in the vicinity of Graffy Bridge. The area occupied south of the road does not fall within the footprint of the proposed construction corridor, therefore there will be no direct impact to nesting birds. As embedded mitigation a nineth turbine was dropped from the finial layout. This turbine was originally proposed for the lands adjacent to the river and therefore construction works for this turbine avoids directly/indirectly impacting on breeding whinchat breeding at this location.

10.(ii).256 The closest proposed turbine location to potential nesting habitat is T8, which is *c*. 200-250 m away, and the closest construction task relates to the excavation for laying cable along the grid connection route that follows the road adjacent to the breeding sites. Given the proximity of the construction works, as well as construction traffic to the nesting locations there is considered to be potential for indirect disturbance to this rare breeding species from inappropriately phased/monitored construction works.

10.(ii).257 The size of the Irish whinchat population is unknown, and Colhoun & Cummins (2013) provide an estimate of 200 pairs, which is marked decline from the range of 1,250-2500 pairs reported in Gibbons *et al.* (1993). This breeding location is certainly of regional significance and the 2 pairs are likely to constitute > 1% of the regional and possibly the population. Therefore, while strictly qualifying as a species with *Medium* sensitivity, whinchat could be assessed as *High* sensitivity due to regional importance. A worst-case scenario would see construction related disturbance resulting in the long-term/permanent abandonment of this location as a breeding site, in which case the magnitude of the effect would be scored as *high* and the potential impact on regional population with *high* sensitivity would be of *very high significance*. This is considered unlikely given the *temporary – short* term nature of construction works, as well as the low intensity of the works scheduled for the Graffy Bridge area; therefore, based on a *low* (possibly *moderate*) magnitude of effect and *medium* species sensitivity, the potential impact was considered to be of *low significance*, requiring appropriate construction phase mitigation.

10.(ii).258 **Grey wagtails** were confirmed breeding along the main stream flowing down the hill through the northern part of the 500 m turbine buffer. Upland eroding streams provide foraging opportunities for this species within the wind farm site and short sections of the main stream provide suitable nesting habitat in relatively steep sided rocky banks, otherwise availability of nest sites was assessed as low and probably limits usage of the area to single pair. Although red listed, grey wagtails are relatively widespread and common on waterways and other water-bodies across Ireland. Severe winters during the last Bird Atlas (Balmer *et al.*, 2013)[114] were thought to contribute to the observed population decline in this species, which although still registering declines appears to be stabilising (Lewis *et al.*, 2019a)[115]. Based on the species red listing the population sensitivity is classed as *Medium*, which is probably appropriate in this instance as this species is sensitive to water pollution.

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

115 Lewis, L. J., Coombes, D., Burke, B., O'Halloran, J., Walsh, A., Tierney, T. D. & Cummins, S. (2019a) Countryside Bird Survey: Status and trends of common and widespread breeding birds 1998-2016. *Irish Wildlife Manuals*, No. 115. NPWS, Department of Culture, Heritage and the Gaeltacht, Ireland.

10.(ii).259 The works corridor between T2 and T3, crosses the stream utilised by breeding grey wagtails. The stream crossing avoids sections identified as potentially supporting nesting birds, therefore there is no risk of direct disturbance to nesting birds. Birds feeding on invertebrates occurring along the streams and rivers in the area, could be displaced due to construction actives; however, given the orientation of the stream within the wind farm site in relation to the works corridor, any disturbance effects are considered *negligible* and therefore *not significant*.

10.(ii).260 A pollution event or prolonged sedimentation affecting the invertebrate populations in the stream would have a negative impact on the grey wagtails utilising the area. However, at the population level, isolated impacts on one pair is unlikely to result in any effect above an impact of *negligible* magnitude, as the populations is estimated at 36,949 to 66,035 birds (Lewis *et al*., 2019a) and therefore the potential impact would be classed as *not significant*. Fortunately, stringent mitigation will be in place during construction to protect water quality due to downstream *Margaritifera* and salmonid populations.

10.(ii).261 **Meadow pipit** are one of the most common and widespread breeding species within wind farm sites and utilise open areas of bog and grassland for nesting, with the most recent population estimates giving a figure of 1,007,407–1,726,880 birds. As with grey wagtail, meadow pipit numbers registered a crash, thought to be linked to consecutive cold winters in 2009/10 and 2010/11, with more recent data indicating the species is staging a recovery. (Lewis *et al*., 2019a). These declines contributed to meadow pipit being assigned to the red list, and therefore populations are considered to have *Medium* sensitivity.

10.(ii).262 Meadow pipits are ground nesting species with the potential to set up breeding sites in cover within the works corridor. Therefore, in the absence of mitigation there is the potential for direct impact on nesting meadow pipit, which would result in a *Low* magnitude of effect with the potential impact was considered to be of *Low significance*, requiring appropriate mitigation. Poorly timed construction works and the alteration of foraging habitat have the potential to result in secondary impacts causing the abandonment of breeding sites and displacement of foraging birds, again of *Low significance*. Meadow pipits are also common prey item for many species including merlin, which nest in the area and significant displacement of meadow pipits could potentially affect productivity within higher trophic levels.

10(ii) 5.3.2.11 Sparrowhawk – Potential construction phase impacts

10.(ii).263 A sparrowhawk breeding territory was identified in the area around T1. Inappropriately timed/phased construction works have the potential to result in direct disturbance to a nesting sparrowhawk. Despite declining numbers, sparrowhawk remain a common and widespread raptor in Ireland (8,746 – 14,252 pairs in Lewis *et al.* 2019)[116] and on a country wide population basis this magnitude of effect to a single pair would be considered *negligible*. If considering the magnitude of the effect on local sparrowhawk populations then the magnitude would be assessed as *moderate* (*c.* 10% of local population affected).

10.(ii).264 A felling buffer (*c.* 100 m) is required around T1 and therefore it is highly likely that this breeding site will be displaced. It is understood that this species, which often nests in commercial forestry plantation will be relatively tolerant of felling operations and should be able to readily relocate in the remaining woodland adjacent to the development. In terms of foraging birds, it is considered that construction activities are unlikely to cause any substantial disturbance/displacement effects and therefore is considered *not significant*.

10.(ii).265 The significance matrix in **Table 5**, for a species with *Low* sensitivity as an Amber listed population and potential impacts with *negligible* magnitude of effects returns an impact of *not significant* for both direct/indirect disturbance on breeding sparrowhawk. If considering magnitude of effects at a local population level, then a *moderate* effect can be expected, which returns an impact of *very low significance*. In this instance impacts will be minimised through project design to ensure removal of vegetation at appropriate times of the year, i.e. out of the breeding season.

10(ii) 5.3.2.12 Kestrel – Potential construction phase impacts

10.(ii).266 While the nest locations utilised during the 2019 and 2020 breeding seasons are beyond the 500 m turbine buffer, based on the current turbine layout, there is potential nesting habitat within the works corridor (trees at T4); and therefore, if birds shifted nest site during the build there is potential for inappropriately monitored/phased construction works to result in direct disturbance of a kestrel nest.

10.(ii).267 In 2020 the nest site was located on a cliffy ravine *c.* 1 km WNW of T7, which would be considered beyond the zone of sensitivity for most similar raptor species – see merlin. Kestrel exhibit a level of tolerance to human related disturbance and for example regularly nest in active quarries. Therefore, unless the existing nest site shifts significantly closer to the works corridor, it is considered unlikely that there will be indirect disturbance to breeding kestrels during construction.

10.(ii).268 Kestrels were regularly recorded foraging and flying through the 500 m turbine envelope during baseline surveys and it is considered that construction activities may have a localised effect, displacing individuals foraging though the area. However, in consideration of, the relatively tolerant nature of kestrels to certain kinds of human disturbance, the discreet nature of the proposed

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116 Lewis, L. J., Coombes, D., Burke, B., O'Halloran, J., Walsh, A., Tierney, T. D. & Cummins, S. (2019a) Countryside Bird Survey: Status and trends of common and widespread breeding birds 1998-2016. *Irish Wildlife Manuals*, No. 115. NPWS, Department of Culture, Heritage and the Gaeltacht, Ireland.

construction works within the wider landscape and the availability of alternative foraging areas, as well as the temporary – short term nature of the proposed construction works, potential secondary impacts on foraging kestrels are considered of *negligible* magnitude and therefore *not significant*.

10(ii) 5.3.2.13 Snipe – Potential construction phase impacts

10.(ii).269 Snipe breed within the 500 m turbine buffer; at relatively low densities with at least two, possibly threes territories recorded – located in the bog above T5, T6, T7 (Graffy Hill) and bog/wet grassland north of VP3 (NE of proposed sub-station). Density of use over the winter was also considered relatively low, probably a function of better wintering habitat in the wider area.

10.(ii).270 The turbine locations and construction corridor avoid the wetter areas within the 500 m turbine buffer, which have been highlighted as snipe breeding habitat. Therefore, there will be no direct impacts on breeding snipe, as suitable areas of snipe habitat are being avoided.

10.(ii).271 There is potential for secondary impacts on breeding/wintering snipe during construction, with disturbance factors potentially resulting in the temporary displacement of small numbers of breeding/wintering birds. Pearce-Higgins *et al.* (2009, 2012)[117; 118] suggest snipe may be displaced up to 400 m from turbines and that construction may reduce snipe densities by up to 53%. Relating this level of displacement to the current wind farm proposal (2-3 pairs of snipe), generates a worst-case scenario of 1 to 2 birds displaced. However, application of the Pearce-Higgins *et al.* study to sites with sub-optimal snipe habitat may not be valid; and during weekly ornithological monitoring conducted on wind farm construction sites by Woodrow surveyors working in similar habitats to Graffy, territorial snipe have regularly been found chipping away adjacent to the work corridor, often at higher densities than reported by pre-construction surveys (although this is likely to be influenced by increased survey effort during construction).

10.(ii).272 Given the *Low* conservation sensitivity of snipe, the relatively small numbers of pairs (2-3 pairs) and wintering birds potentially impacted, as well as the *temporary – short term* nature of the construction works, it is considered that the potential indirect impact of construction disturbance on breeding/wintering snipe is of *Low* magnitude and therefore of *very low significance*.

10(ii) 5.3.2.14 Jack snipe – Potential construction phase impacts

10.(ii).273 Jack snipe were recorded at the edge of the 500 m turbine buffer once during a VP watch. Jack snipe do not breed in Ireland and it is likely that this bird was passing through on migration or may

117 Pearce-Higgins, J.W., Stephen, L., Langston, R.H.W., Bainbridge, I.P. & Bullman, R. (2009). The distribution of breeding birds around upland wind farms. *Journal of Applied Ecology*, 46, 1323–1331.

118 Pearce-Higgins, J.W., Stephen, L., Douse, A. & Langston, R.H.W. (2012). Greater impacts of wind farms on bird populations during construction than subsequent operation: results of a multi-site and multi-species analysis. *Journal of Applied Ecology*, 49, 386–394

have been overwintering in the area. Although jack snipe naturally tend to occur at low densities, the proposed wind farm site was not considered an important site for this species. Given the low level of recorded site usage, the *Low* population sensitivity and the *negligible* magnitude of effects; it is considered that the potential impacts of construction disturbance on jack snipe is *not significant*.

10(ii) 5.3.2.15 Amber listed breeding passerines – Potential construction phase impacts

10.(ii).274 The assemblage of breeding passerines occurring within the wind farm site are associated with either open upland habitats or coniferous commercial plantations, with the lower lying agricultural grasslands and river valley, as well as the nearby mountain ranges exerting an influence on the avi-fauna at this location. Habitats and associated breeding amber listed passerines that have the potential to be directly impacted during construction by virtue of occurrence within or directly adjacent to works corridor include:

- open areas of blanket bog/unimproved acid grassland provide suitable habitat for ground nesting amber listed species, notably skylark and where small patches of scrub occur stonechat (Note: Based on limited habitat availability and low densities recorded the occurrence of breeding wheatear within the works corridor is considered unlikely).
- conifer plantations with associated scrub cover are suitable for a range of species including amber listed breeding goldcrest, mistle thrush and robin.

10.(ii).275 Amber listed species that were recorded foraging only (house martin; and swift – not a passerine), breeding in houses (swallows and starlings) and those associated with mature stands of woodland (spotted flycatcher) will not be directly impacted during construction. Suitable nesting habitats utilised by these species do not occur within the works corridor or where habitats occur close-by (specifically, along the grid connection route) important features, such as the patches of more open broadleaf woodland favoured by spotted flycatcher will not be affected by the construction works.

10.(ii).276 Inappropriately timed/phased construction works have the potential to result in direct disturbance to a range of amber listed breeding birds, including: skylark, stonechat, goldcrest, mistle thrush and robin. These species, as with the majority of the passerines recorded within the wind farm site are considered relativity abundant and widespread species (Crowe *et al*., 2014 & Lewis *et al*., 2019), which have high reproductive rates with populations that are unlikely to be affected to any degree by the scale of works proposed, and the magnitude of the effect would be classed as *negligible*. However, due to the localised potential for breeding disruption in some species, notably skylark the magnitude of impact is considered to be *negligible* to *low*. Skylark, potentially exhibit higher levels of sensitivity to construction and based on Pearce-Higgins *et al.* (2009)[119] standoff distances around active skylark nests of 100-200 m are often employed during construction. Lower levels of sensitivity to disturbance, are typically associated with those species nesting within scrub habitat. This assemblage of Amber listed species are classed as features of *Low* population sensitivity, therefore it is considered that potential direct impacts of construction in the absence of appropriate mitigation is of *very low significance.*

10.(ii).277 Disruption to the foraging activity of birds due to construction is likely to have a localised effect, potentially leading to displacement of more sensitive species of passerine. However, given the spatially and temporally constrained nature of the works, and the wide availability of alternative foraging habitats adjacent to the works corridor the magnitude of any effect is considered *negligible* on a species assemblage of *low* population sensitivity. Therefore, the potential impacts on foraging amber listed passerines during the construction phase of the project is considered *not significant.*

10(ii) 5.3.2.16 Buzzard – Potential construction phase impacts

10.(ii).278 Buzzards have been cited as being sensitive to disturbance at wind farms (Pearce-Higgins, 2009)[120], although this has been measured in relation to wind turbine impacts rather than construction impacts. Buzzards routinely forage through the site; therefore, it can be assumed that there will be a level of disturbance from certain operations during construction works and it is possible that disturbance during construction works may result in the displacement of foraging birds to another area. However, the terrain and size of the site means that the effects of disturbance are unlikely to be far ranging during the construction phase. Taking account of this, and the unrated conservation importance of buzzard in Percival (2003), it is considered that the potential impact of construction disturbance on buzzard is *negligible* and therefore *not significant.*

10(ii) 5.3.2.17 Wintering woodcock – Potential construction phase impacts

10.(ii).279 Records of woodcock were limited to wintering birds, which utilise the forestry/scrub within the wind farm site to roost up during the day and are likely to forage in the bog/wet acid grassland during the night. The wintering and breeding populations are considered to be different, with only the declining breeding population being BoCCI Red listed; therefore, at this location, wintering woodcock populations are classed as not being sensitive (Percival, 2003).

10.(ii).280 Construction activities conducted over the winter are likely to displace woodcock from roosting cover within and adjacent to the works corridor. However, the constrained nature of the works and

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119 Pearce-Higgins, J.W., Stephen, L., Langston, R.W., Bainbridge, I.P. & Bullman, R. (2009). The distribution of breeding birds around upland wind farms. *Journal of Applied Ecology*, 46: 1323-1331.

120 Pearce-Higgins, J. W., Stephen, L., Langston, R. H. W., Bainbridge, I. P. and Bullman, R. (2009). The distribution of breeding birds around upland wind farms. Journal of Applied Ecology. Vol 46 pp 1323-1331.

fact that there is an abundance of alternative cover in the area means the magnitude of effect is considered *negligible*. Therefore, the potential disturbance/displacement of wintering woodcock due to proposed construction activities is consider to be *not significant*.

10(ii) 5.3.2.18 Non-breeding gull – Potential construction phase impacts

10.(ii).281 Construction related disturbance has the potential to displace non-breeding great black-backed gulls, lesser black-backed gulls and herring gulls from the area surrounding the works corridor. Work on the grid connection route will bring construction activities closer to the hotspot of gull activity in the area – the mink farm, which neighbours the Tievebrack sub-station and is the final destination for connection to the grid.

10.(ii).282 However, any significant levels of disturbance are considered unlikely based on gulls exhibiting high levels of habituation to human activity, often drawn to it as an opportunist source of food. In addition, as outlined in **Section 10(ii) 5.3.2.18** usage of the wind farm site by gull species was limited to birds occasionally flying through the site, with only one observation of a great black-backed gull opportunistically foraging on carrion within the site. In view of the non-breeding status of gulls at this location (Mitchell *et al*., 2004[121] and Cummins *et al*., 2019[122]), meaning they are considered to have a lower population sensitivity and the *negligible* magnitude of effects anticipated; it is considered that construction related impacts on non-breeding gulls are *not significant*.

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

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

10(ii) 5.3.3 Operational Phase Impacts

10.(ii).283 The potential impacts on birds during the operational phase can be due to disturbance/displacement from:

- operational activities and servicing - though this would be limited to relatively few visits per year and would not be considered to add significantly to existing/background levels of human activity in the area
- the operating turbines themselves and associated habitat loss

10.(ii).284 There is potential for poorly designed, engineered and/or constructed wind farm infrastructure, to result in increased runoff and sedimentation, specifically drainage associated with turbine hardstands and access tracks. Potential for any accidental hydrocarbon pollution during the operational phase of the project would be limited to rare accidental spillages from small volumes of service vehicles periodically accessing the wind farm site. Deterioration in water quality has the potential to impact on birds reliant on aquatic habitats, such as kingfisher, dipper, grey wagtail or heron.

10.(ii).285 Potential impacts can also be due to direct impacts on birds in terms of mortality caused by collision with the turbines and associated overhead infrastructure. Although there has been little in the way of documented raptor collisions with wind turbines in Ireland and the UK (see - Fennelly, 2015)[123], there are concerns that raptors and large waterfowl (e.g. geese and swans) are some of the more sensitive to collision risk (e.g. Hötker *et al.* 2006[124], Madders & Whitfield 2006[125], Drewitt & Langstone 2008[126]).

10.(ii).286 A collision risk model has been developed by Scottish Natural Heritage (SNH, 2000[127]). There are a number of assumptions built into this model and results are improved through a data collection approach throughout the survey that best facilitates input into the model (specifically time spent by target species at flight heights that may bring them into contact with turbines). The fieldwork approach for the proposed development was specifically designed to allow the use of this model. The model has since been updated to take account of avoidance action by birds (SNH, 2010[128]).

123Fennelly, R.F. (2015). A Review of Bird Strike Mortality at Irish Onshore Windfarms. *CIEEM in-practice* Issue 88 June 2015

124 Hötker, H., Thomsen, K.M. & Jeromin, H. (2006). Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats - facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation. Michael-Otto-Institut im NABU, Bergenhusen.

125 Madders, M. and Whitfield, D. P. (2006). Upland raptors and the assessment of wind farm impacts. *Ibis* Vol 148 pp 43-56.

126 Drewitt, A. L., Langston, R. H.W. (2008) Collision Effects of Wind-power Generators and Other Obstacles on Birds. *Annals of the New York Academy of Sciences* 1134:1, 233-266, Online publication date: 1-Jun-2008

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

128 SNH (2010). Use of Avoidance Rates in the SNH Wind Farm Collision Risk Model. Guidance Note Series. Scottish Natural Heritage.

10.(ii).287 All models, and the assumptions they are based on, are open to scrutiny. A study by the British Trust for Ornithology (BTO) on the SNH collision risk model (Chamberlain *et al.* 2005[129]) found the model to be statistically robust, but lacking with respect to its lack of consideration of avoidance rates. The issue of avoidance rates has since been addressed (though understanding on these is still developing for certain species). It is considered, therefore, that the use of the SNH collision risk assessment model is appropriate for this study.

10.(ii).288 Use of the SNH collision risk study, running data from VP watches over 2-years between Oct-2018 and Aug-2020 inclusive, provided calculations relating to predicted collisions for a range of target species recorded within the 500 m turbine envelope. Details of methodology and assumptions are provided in **Appendix 6**, which outlines the CRM – collision risk model undertaken. **Table 13** in **Appendix 6** provides predicted collisions/mortality for target species, representative of a worst-case scenario employing Nordex 133, with **Table 12** in **Appendix 6** providing CRM outputs if Enercon E-126 are used. A summary of predicted collisions is provided **Table 8**, which gives weighted values for both turbine specifications (adjusted to correct for overlapping viewsheds, turbine downtime and avian seasonal activity), with appropriate species-specific avoidance rates applied.

Table 8. Summary of predicted collisions / mortality – weighted with avoidance rates applied

Species	Turbine model	Collisions per annum (with avoidance)	Collisions per decade	Collisions per 30 years (lifespan)	Equivalent to one bird every:
Whooper swan	Nordex 133	0.03	0.25	0.76	39.73 years
	Enercon E-126	0.02	0.22	0.65	46.30 years
White-tailed eagle	Nordex 133 (**95**% avoid.)	0.26	2.56	7.68	3.91 years
	(**98**% avoid.)	0.09	0.93	2.79	10.77 years
	Enercon E-126 (**95**% avoid.)	0.24	2.44	7.32	4.10 years
	(**98**% avoid.)	0.09	0.89	2.66	11.30 years
Hen harrier	Nordex 133	0.00	0.04	0.12	249.97 years
	Enercon E-126	0.00	0.04	0.11	261.76 years
Sparrowhawk	Nordex 133	0.01	0.08	0.25	118.48 years
	Enercon E-126	0.01	0.08	0.24	124.26 years
Buzzard	Nordex 133	0.19	1.93	5.80	5.17 years
	Enercon E-126	0.18	1.84	5.53	5.43 years
Golden eagle	Nordex 133	0.06	0.58	1.73	17.32 years
	Enercon E-126	0.06	0.55	1.65	18.17 years

129 Chamberlain, D., Freeman, S., Rehfisch, M. (2005). Appraisal of Scottish Natural Heritage's Wind Farm Collision Risk Model and its Application. BTO Research Report 401. BTO. Thetford.

Species	Turbine model	Collisions per annum (with avoidance)	Collisions per decade	Collisions per 30 years (lifespan)	Equivalent one bird every
Kestrel	Nordex 133	0.17	1.67	5.01	5.99 years
	Enercon E-126	0.16	1.59	4.77	6.28 years
Merlin	Nordex 133	0.02	0.24	0.73	40.92 years
	Enercon E-126	0.02	0.23	0.70	42.92 years
Snipe	Nordex 133	0.04	0.43	1.29	23.31 years
	Enercon E-126	0.04	0.41	1.23	24.45 years
Lesser black-backed gull	Nordex 133	0.02	0.18	0.54	55.76 years
	Enercon E-126	0.02	0.17	0.51	58.49 years
Herring gull	Nordex 133	0.14	1.36	4.09	7.33 years
	Enercon E-126	0.13	1.30	3.90	7.69 years
Great black-backed gull	Nordex 133	0.01	0.08	0.23	129.91 years
	Enercon E-126	0.01	0.07	0.22	136.25 years

10.(ii).289 Based on the low levels of flight activity recorded for target species within the 500 m turbine buffer and at flight heights within the collision risk zone, with regard to population sensitivities, it can be concluded that the proposed development once operational does not pose a significant collision risk to whooper swan, hen harrier, sparrowhawk, merlin, snipe, gull species (although predicted mortality for herring gull was higher than other species, this was driven by a single recorded of 150 birds flying into the area and it is considered that there is no population level risk associated with the proposed development).

10.(ii).290 Predicted collision risk for white-tailed eagle, golden eagle, buzzard and kestrel requires further examination.

10(ii) 5.3.3.1 Special Protection Areas - Potential operational phase impacts

10.(ii).291 As outlined in **Section 10(ii) 4.1.3**, the Application Site is not within or adjacent to any Special Protection Areas. Designated areas considered as having potential ornithological links with the proposed development included Derryveagh and Glendowan Mountains SPA, Lough Nillan Bog SPA and Sheskinemore Lough SPA. The QI species for these SPAs included: breeding red-throated diver, peregrine, merlin, golden plover and dunlin and wintering Greenland white-fronted geese.

10.(ii).292 Breeding red-throated diver, peregrine, golden plover and dunlin were not recorded as occurring within or adjacent to the Application Site during surveys. Likewise, wintering Greenland white-fronted geese were not recorded as occurring within or adjacent to the Application Site during surveys. For these five species, it is considered there is no ecological link between the Application Site and designated bird populations within the Derryveagh and Glendowan Mountains SPA, Lough Nillan Bog SPA and Sheskinemore Lough SPA; and therefore, no potential for impact by direct or indirect during the operational phase.

10.(ii).293 Merlin are a QI for both Derryveagh and Glendowan Mountains SPA and Lough Nillan Bog SPA. Merlin nested in a location adjacent to the Application Site and there is a potential for operational activities to result in direct impacts (collision with turbines/new fencing). If mortality due to the proposed development results in > 1% increase on background mortality rates for merlin; then it is considered that the merlin population within both neighbouring SPAs has the potential to be adversely impacted. As discussed in **Section 10(ii) 4.3.5** and illustrated by maps in **Appendix 7**, on the basis of spatial separation between the breeding site and SPAs, which are either close to or surpass the maximum territory size of 6 km reported for this species; the pair associated with the proposed development is considered unlikely to comprise a part of the population of the Lough Nillan Bog SPA and does not form a part of the population within the Derryveagh and Glendowan Mountains SPA.

10.(ii).294 Operational turbines and the footprint of the development (including new fencing) have the potential to result in the displacement of foraging birds, with the possibility of impacting on productivity and leading to displacement of breeding merlin. Displacement of this pair during the breeding season, could put pressure on neighbouring pairs in terms of nest competition, which could adversely affect merlin populations within both neighbouring SPAs.

10.(ii).295 The likelihood and consequences of operational activities resulting in impacts on the resident pair of merlin are discussed in the following sections (**Section 10(ii) 5.3.2.2**).

10.(ii).296 A potential (but distant) hydrological link was identified between the wind farm site and a downstream designated site; the Lough Foyle SPA, which is a cross border SPA designated for a range of waterbird species. There is potential for poorly designed, engineered and/or constructed wind farm infrastructure, to result in increased runoff and sedimentation, specifically drainage associated with turbine hardstands and access tracks. A worst-case scenario has the potential for significant effects on downstream QIs within the Lough Foyle SPA. However, the hydrological connection is relatively distant (*c.* 77 km downstream); and in view of dilution effects and limited sensitivity of waterbirds receptors to low (background) levels of aquatic pollution; as well as the stringent mitigation measures that are a mandatory design phase requirement for construction works upstream of sensitive salmonid and *Margaritifera* catchments, it is considered that it is highly unlikely that QI species of the Lough Foyle SPA would be impacted during the operation of the proposed project, even in the event of a worst-case scenario accidental pollution event.

10(ii) 5.3.3.2 Merlin - Potential operational phase impact

10.(ii).297 This section is supported by detailed maps in **Appendix 7**, which is a confidential appendix providing potentially sensitive information on merlin breeding activity adjacent to the wind farm site, including flight-lines and nesting locations.

10.(ii).298 The baseline study found a pair of merlin nesting in a location adjacent to the wind farm site. In the original project design T1, T2 and T3 (as surveyed) were closer to the merlin nest sites occupied in 2019/2020, resulting in both these nest locations falling within the 500 m turbine buffer. The final turbine layout has resulted in the 500 m turbine buffer being shifted away from the nests to establish a more appropriate standoff. This also resulted in much of the flight activity originally recorded as being within the turbine envelope is now classed as falling beyond the 500 m turbine buffer. Prior to re-positioning of turbines, merlin flights within the 500 m turbine buffer amounted to 2,102 seconds and were subsequently reduced to 1,377 seconds considering the final positions selected for T1 and T2. Breeding season VP watches accounted for > 90% of the flight time recorded and the CRM was run to account for the higher breeding season usage of the area.

10.(ii).299 Despite high densities of overall flight activity in the area, which was associated with the nest site, the CRM returned a low level of predicted collision risk for merlin. The worst-case predicted collision risk (weighted and applying avoidance rate) was low, 0.73 collisions over 30 years (see **Table 8**). This was largely due to the low flight heights that are typically undertaken by merlins, predominately below the rotor swept area. There was one prolonged flight record (*c*. 11 mins) during the 2019 breeding season (17-Apr-2019), when the female was flushed from a hummock near VP2 by a quad-bike, and the bird ascended rapidly to above the proposed rotor swept area (> 150 m) and circled continuously rising until it was lost in the cloud base at *c*. 180 m (See **Obs. 4** in **Appendix 7 – Figure 1** & **Table 1**).

10.(ii).300 The CRM model was run using a minimum rotor swept height of 18 m for the Nordex 133 turbines, which is considered the most extreme turbine set-up proposed for this location, and further reduction in predicted collision risk would be achieved by employing a higher minimum rotor swept height, e.g. 25 m as for the Enercon E-126 turbines. A recent industry trend aimed at lowering maximum tip heights of turbines, while retaining turbine diameter, is seeing the use of low hub heights and resulting in rotor swept areas as low as 15 m now requiring assessment. Such a scenario would see increased predicted collision risk for low flying species like merlin, sparrowhawk and red grouse.

10.(ii).301 As reviewed in Madder & Whitfield (2006)[130] relying on VP watch data and the resultant CRMs may not be an appropriate methodology for assessment of an elusive species like merlin, which for example may alter flight behaviour to evade detection by observers. The Graffy pair was certainly very conspicuous around the nest site, but flights in areas away from the nest were less regularly detected, especially over the 2019 breeding season when the nest location used was not directly visible from VP2.

10.(ii).302 Published data is lacking on turbine avoidance rates for merlin and SNH (2018)[131] recommend applying a conservative rate of 98% in the CRM for species where no avoidance rate exists. Although there are a small number of collisions attributed to turbines (Fennelly, 2015[132], Hötker, 2006[133], Watson, 2018[134]) wind farms are generally considered to pose a low collision risk for merlin, which exhibit agile, fast flight behaviour predominately below the rotor swept volume (as described in Hardey *et al.*, 2009[135], McElheron, 2005[136]). Therefore, based on low levels of predicted collision risk for merlin and on the proviso that lowest extent of the rotor swept volume remains > 20 m, it is considered that the magnitude of effect is *negligible*. Therefore, although merlin is classed as having *Very High* sensitivity at this location, the potential impact due to collision risk from turbines was found to be *not significant*.

10.(ii).303 The low flight heights, especially while hunting at speed, means merlins are more likely to be at risk of colliding with any new fences that may be associated with the development. In addition to posing a potential collision risk, fencing fragments the the open aspect of the landscape and may limit the effectiveness of the low hunting flights undertaken by merlin. Fencing around turbine bases and access tracks would amount to significant lengths of new obstacles with the potential of reducing the profitability of the area for merlin; and could result in displacement from foraging areas that may contribute to reduced productivity of the resident pair and eventual displacement from the breeding site. The likelihood of direct impacts from the erection of new fences, as well as the potential for displacement due to a reduced habitat quality is unknown, and may be influenced by the tolerance of individual birds or pairs.

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130 Madder & Whitfield (2006). Upland raptors and the assessment of wind farm impacts. *IBIS* 148:1 43-56

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

132 Fennelly, R.F. (2015). A Review of Bird Strike Mortality at Irish Onshore Windfarms. *CIEEM in-practice* Issue 88 June 2015

133 Hötker, H., Thomsen, K.M. & Jeromin, H. (2006). *Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats - facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation.* Michael-Otto-Institut im NABU, Bergenhusen.

134 Watson, R.T. (2018). Raptor Interactions with Wind Energy: Case Studies from around the World. *Journal of Raptor Research* 52(1): 1-18. Raptor Research Foundation

135 Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. & Thompson, D. (2009). *Raptors: a field guide for surveys and monitoring.* 2nd Ed. Stationery Office, Edinburgh

136 McElheron, A. (2005). *Merlins of the Wicklow Mountains*

10.(ii).304 Once operational it is understood that the servicing of the wind farm will not add significantly to the background levels of disturbance currently occurring in the area. The potential displacement due to the operational disturbance effects of the turbines on breeding merlins needs to be considered. Tolerance to operational turbines is likely to be determined to some extent by individual traits and probably habituation over time. Superficially, the pair currently inhabiting the area appear to be relatively tolerant of some disturbance, as they nest relatively close to a road and an occupied farmstead.

10.(ii).305 Being such an elusive species there is limited information on the observed impacts of wind farms on merlins and to fill the information void requires to reliance on professional experience. Post-construction surveys on operational wind farms conducted by Woodrow have observed breeding behaviour at two wind farm sites, with a nest within 400-500 m at one site (operational 23 years) and 200 m on the other site (Year 1 post-construction) – distances measured to closest turbine towers. On the older operational site, a female merlin was recorded hunting along a track running directly below two turbines, in pursuit of a meadow pipit and over a two-year monitoring period merlins were regularly recorded during the breeding season within the 500 m turbine buffer.

10.(ii).306 The closest turbines to the known nest locations are T1 (*c*. 600/680 m), T2 (*c*. 570/710 m), T3 (*c*. 600/770 m), T4 (*c*. 830/950 m) - measurements given are for both nest locations to rotor swept area, i.e. add 80 m for distance to base of tower. This places the turbine array beyond 500 m from the known nest sites, which is the maximum exclusion zone buffer employed around nest sites designed to limit the impacts of human disturbance on breeding merlin (as reviewed in Ruddock & Whitfield, 2007)[137].

10.(ii).307 While turbines are located beyond published standoffs, taking a precautionary approach with consideration given to the relatively unknown disturbance/displacement effect that operational turbines might have on the breeding merlin site; as well as the requirement for design phase mitigation to limit the length/placement of fencing and to stipulate minimum rotor swept heights - the magnitude of effect is considered to be *low*. Therefore, as the sensitivity of the merlin population at this location is considered *very high*, the potential indirect operational impacts are of *medium significance* and requiring carefully considered mitigation measures to be implemented.

137 Ruddock, M. & Whitfield, D. (2007). *A review of disturbance distances in selected bird species*. A report from Natural Research (Projects) Ltd to Scottish Natural Heritage.

10(ii) 5.3.3.3 White-tailed eagle – Potential operational phase impacts

10.(ii).308 A Norwegian study found that white-tailed eagles show weak behavioural responses to wind farm avoidance, especially sub-adult birds (Dahl *et al.*, 2013)[138] and are not displaced by turbines (May *et al.* 2015)[139]. This behavioural trait has contributed to high levels of mortality in this species and even in Ireland a number of eagles have been killed due to turbine collisions (Fennelly, 2015)[140]. In the context of potential operational impacts at the proposed wind farm site, the results from Norwegian research suggest that collision risk, rather than displacement of birds is the core issue. Therefore, the effect of displacement due to the footprint of the operational wind farm is considered to be *negligible* and therefore *not significant*. Furthermore, over the baseline study white-tailed eagle flight activity through the 500 m turbine buffer was recorded intermittently and involved several different birds, which demonstrates that birds are not exclusively or even moderately reliant on the proposed development site as a foraging, roosting or socialising area.

10.(ii).309 It is considered that usage of the wind farm site was typically by birds commuting through the area, with birds utilising the southern slopes of Aghla Mountain to soar and forage. Foraging activity, when observed within or adjacent to the wind farm site was typically associated with carrion on the hill, which was reported as abundant and regularly available, particularly during the second study year. One extended bout of activity within the 500 m turbine envelope was associated with a dead sheep carcass. Eagles in general were recorded more often along the slopes of Aghla Mountain, above the proposed wind farm site.

10.(ii).310 White tailed eagles were seen on seven dates (eight observations) during VP watches within the 500 m turbine buffer and were recorded flying within buffer for 3,694 seconds; and 3,134 seconds judged to be at heights within the collision risk zone. The majority of this time (2,480 seconds) was accounted for by the bird mentioned above foraging on carrion (a dead sheep) over two consecutive days (28 & 29-Apr-2020). The carrion attracting the bird into the area was located on the edge of forestry within the north-western boundary of the 500 m turbine buffer.

10.(ii).311 Based on observed flight activity within the 500 m turbine buffer, the worst-case collision risk (weighted and applying avoidance rate) was predicted to be 7.32 collisions over 30 years, equivalent to 1 bird every 3.9 years. Although the Irish white-tailed eagle population appears to be expanding, there is uncertainty over the size of the population and survival rates; nevertheless, given the small size of the population (12 pairs, A. Mee, IRSG, 2018), the level of mortality

138 Dahl, E. L., May, R., Hoel, P. L., Bevanger, K., Pedersen, H. C., Røskaft, E. & Stokke, B. G. (2013). White-Tailed Eagles (*Haliaeetus albicilla*) at the Smøla Wind-Power Plant, Central Norway, Lack Behavioral Flight Responses to Wind Turbines. *Wildlife Society Bulletin* 37(1): 66-74

139 May, R., Reitan, O., Bevanger, K., Lorentsen, S.-H. & Nygård, T. (2015). Mitigating wind-turbine induced avian mortality: Sensory, aerodynamic and cognitive constraints and options. *Renewable and Sustainable Energy Reviews* 42 (2015) 170–181

140 Fennelly, R.F. (2015). A Review of Bird Strike Mortality at Irish Onshore Windfarms. *CIEEM in-practice* Issue 88 June 2015

predicted has the potential to have an adverse impact at the population level and if realised would result in an increase in annual mortality > 1%.

10.(ii).312 The CRM for white-tailed eagle was run using a conservative avoidance rate of 95%., as well as using max cord length 4 m (not average), relatively fast average rotational period (5 sec) and relatively extreme pitch (25°), which increases the time/volume over which the volume of the bird must fly to avoid collision. The model was also set to account for the larger flight volume presented by flapping, as opposed to gliding flight.

10.(ii).313 Applying a higher avoidance rate when re-running the model and using an avoidance rate of 98% (as described in May *et al*., 2011 [141] and based on studying collision risk using radio tagged birds and actual mortality rates for white-tailed eagles at a wind farm site in Norway) generates a lower predicted value for collision related mortality, with a worst-case scenario (Nordex 133) of 2.79 collisions predicted over 30 years, equivalent to 1 bird every *c*. 10.8 years. The predicted risk is lowered marginally when the model is run using the specifications of the smaller alternative turbine (Enercon E-126) of 2.66 collisions predicted over 30 years, equivalent to 1 bird every *c*. 11.3 years.

10.(ii).314 As a crude estimate, based on annual survival rates of 0.936 for adult eagles (birds > 3 years old) and 0.395 for sub-adults (BTO)[142]; if the Irish white-tailed eagle population supported roughly 38 pairs/adult birds and 85 sub-adults (*c*. 161 birds in total); then the potential increase in predicted annual mortality due to collisions would be less than 1% (for 98% avoidance rates, worst case scenario) and considered to have *negligible* effect (Percival, 2003). This is a substantially higher population estimate than the currently reported population, which is probably less than 40 birds (IRSG Annual Reviews 2016, 2017, 2018).

10.(ii).315 Obviously, there are notable difficulties in utilising models for a pioneering population that ranges as widely as white-tailed eagles and where the demographics and size of the population is not fully known. In addition, when considering a relatively small population the potential risk of collision with turbines may impact disproportionately across a population's spatial distribution. Nevertheless, based on a conservative predicted collision risk (employing lower 95% avoidance rate) the proposed wind farm site (0.26 birds per annum) and for a population of 36 birds (with c. 30% sub-adult birds) the additional mortality is < 5%. Percival (2003) considers the magnitude of this effect as *Low* (- a small but discernible reduction in the size or productivity of the population).

10.(ii).316 Therefore, taking a precautionary approach that accounts for the species' *high* population sensitivity and the *low* magnitude of effect, the potential direct impact due to collision on foraging

141 May R, Nygård T, Dahl EL, Reitan O, Bevanger K. (2011). *Collision risk in white-tailed eagles. Modelling kernel-based collision risk using satellite telemetry data in Smola wind-power plant*. Norwegian Institute for Nature Research 2011: 22. Trondheim, Norway.

142 British Trust for Ornithology BTO BirdFacts | White-tailed Eagle - Robinson, R.A. (2005) *BirdFacts: profiles of birds occurring in Britain & Ireland*. BTO, Thetford (http://www.bto.org/birdfacts, accessed on 10 Jan-2021)

white-tailed eagle was classed as being of *low significance*. This is considered appropriate at this time; as over the two-year study, no breeding sites were located within the 6 km turbine buffer. Although white-tailed eagles were prospecting in the wider area, it was considered that the availability of suitable nesting habitat within the 2 km buffer was limited. In addition, activity within the site was driven by birds opportunistically exploiting the occurrence of carrion on the periphery of the 500m turbine buffer, rather than sustained usage of the proposed development site.

10(ii) 5.3.3.4 Hen harrier – Potential operational phase impacts

10.(ii).317 There are relatively few documented cases of hen harrier mortality due to turbine collisions in Ireland (e.g. Fennelly, 2015[143] & GreenNews.ie, July 2019[144]) and reporting of fatalities at wind farms is at low frequency, even if reviewing records from abroad (Whitfield & Madders, 2006[145] & Haworth & Fielding, 2012[146]). Flight heights typically below rotor swept volumes, combined with high rates of avoidance results in low predicted collision risk for most wind farm sites monitored. Based on studies on observed behavioural avoidance SNH (2018) recommends the application of 99% avoidance rate for hen harriers in collision risk modelling for this species (Whitfield & Madders, 2006).

10.(ii).318 VP watches conducted at the proposed wind farm site generated 296 seconds of flight line data within the 500 m turbine buffer, of which 112 seconds was determined to be at collision risk height. Collision risk (weighted and applying avoidance rate) was estimated to be exceptionally low at 0.07 collisions over 30 years. Based on low recorded usage of the wind farm and very low predicted collision risk, the magnitude of effect due to direct operational impacts are considered *negligible* for hen harrier and therefore *not significant*.

10.(ii).319 Studies of hen harrier behaviour at operational wind farms suggests a degree of avoidance around active turbines, with Pearce-Higgins *et al.* (2009)[147] finding that birds avoided flying within 250 m of turbines. A review for SNH conducted by Haworth & Fielding (2015) found no evidence of decreases in activity post-construction and reported relatively small scales of displacement from turbines ranging from none to 100/200 m. This is supported by an Irish activity study conducted

143 Fennelly, R.F. (2015). A Review of Bird Strike Mortality at Irish Onshore Windfarms. *CIEEM in-practice* Issue 88 June 2015

144 GREEN NEWS.ie https://greennews.ie/hen-harrier-wind-turbine/ -Accessed Dec-2020

145 Whitfield, D.P. & Madders M. (2006). A review of the impacts of wind farms on hen harriers *Circus cyaneus* and an estimation of collision avoidance rates. Natural Research Information Note 1 (revised). Natural Research Ltd, Banchory, UK.

146 Haworth, P. F. & Fielding, A. H. (2012). *A review of the impacts of terrestrial wind farms on breeding and wintering hen harriers*. Report prepared for Scottish Natural Heritage

147 Pearce-Higgins, J.W., Stephen, L., Langston, R.W., Bainbridge, I.P. & Bullman, R. (2009). The distribution of breeding birds around upland wind farms. *Journal of Applied Ecology*, 46: 1323-1331.

by Madden & Porter (2007)[148], which found that post-construction hen harrier activity around turbines returned to pre-construction levels.

10.(ii).320 For UK wind farms Haworth & Fielding (2015) found no evidence for negative effects on nesting locations or productivity. However, an Irish study (Fernández-Bellon *et al.* 2015)[149] while not statically significant, found that hen harrier productivity may be negatively impacted by proximity to turbines. Other Irish research on bird densities in relation to turbine arrays (including prey species of hen harrier) reported in Wilson *et al.* (2015)[150] indicated that bird densities were lower at wind farm sites than at control sites (without turbines), as well as lower closer to wind turbines than at distances further away.

10.(ii).321 There were no hen harrier breeding sites located within the 2 km turbine buffer and recoded usage of the 500 m turbine buffer by hen harriers over the two-year study was limited to on four dates, with all observation occurring out of the breeding season. No winter communal roosts were recorded in the environs of the wind farm site. Therefore, operational turbines may have a localised effect, displacing the occasional individual foraging around turbines. However, in consideration of the discrete, relatively linear nature of the turbine array within the wider landscape, the availability of alternative foraging areas within the wider area and because the intermittent level of recorded usage of the area clearly demonstrates that hen harriers are not exclusively reliant on the proposed wind farm site, potential secondary impacts on foraging harriers are considered of *negligible* magnitude and therefore *not significant.*

10(ii) 5.3.3.5 Golden eagle – Potential operational phase impacts

10.(ii).322 As outlined in **Section 10(ii) 4.3.4** of the baseline study, availability of suitable nesting sites was assessed as limited within 1-2 km of the wind farm site. Employing a radius of 2.5 km around the turbine array to identify a zone of potential '*high sensitivity*' for breeding golden eagle, (as in Bright *et al.* 2006[151] & Bright *et al.*, 2008[152]) sees a marginal increase in the availability of potential nesting habitat and includes more of the western edge of the Blue Stack, specifically the cliffs backing Lough Ea. The published stand-off distances between human activity and golden eagle

148 Madden, B. & Porter, B. (2007). Do wind turbines displace Hen Harriers *Circus cyaneus* from foraging habitat? Preliminary results of a case study at the Derrybrien wind farm, County Galway. *Irish Birds* 8: 231-236.

149 Fernández-Bellon, D., Irwin, S., Wilson, M. & O'Halloran, J. (2015). Reproductive output of Hen Harriers *Circus cyaneus* in relation to wind turbine proximity. *Irish Birds*. 10: 143-150.

150 Wilson, M, Fernández-Bellon, D., Irwin, S. & O'Halloran, J. (2015). *The interactions between Hen Harriers and wind turbines*. Windharrier. Final project report, prepared by School of Biological, Earth & Environmental Sciences, University College Cork, Ireland.

151 Bright, J. A., Langston, R. H. W., J. E. R., Gardner, S., Pearce-Higgins, J. & Wilson, E. (2006). *Bird sensitivity map to provide locational guidance for onshore wind farms in Scotland*. RSPB Research Report No 20.

152 Bright, J., Langston, R., Bullman, R., Evans, R., Gardner, S. & Pearce-Higgins, J. (2008). Map of bird sensitivities to wind farms in Scotland: a tool to aid planning and conservation. *Biol Conserv* 141:2342–2356.

nest sites range from 750 m to 1.5 km (as reviewed in Ruddock & Whitfield, 2007)[153]. Therefore, considering that no nesting activity was recorded within the 6 km turbine buffer and that the probability of future occupancy within 1.5 km of the works corridor was determined to be highly unlikely; it can be objectively concluded that there will be no secondary disturbance impacts to golden eagle breeding sites resulting from the operational wind farm.

10.(ii).323 Some wind farms have been responsible for golden eagle mortality and the most extreme example is the Altamont Pass Wind Resource Area in California where there were several thousand wind turbines that were estimated to be responsible for 40-60 fatalities per annum (Hunt, 2002)[154]. The factors thought to have influenced the high of levels turbine induced mortality in this region was the use of lattice towers and close spacing of turbines, which are now avoided in the design of the more modern wind farm set ups in Ireland.

10.(ii).324 No official or unofficial reports of direct impacts on golden eagles resulting from operational turbines could be sourced for wind farms in Ireland. A recent review on persecution of and threats to raptors in Ireland (O'Donoghue *et al.*, 2020[155]) provides the only documented cases of golden eagle mortality Ireland, which involves the direct poisoning of two birds. While post-construction monitoring on wind farms in Ireland is likely to have been deficient, specifically turbine searches for victims of collision, it is circumstantially interesting to note that no fatalities have been reported from operational wind farm in Co. Donegal, where there are clusters of wind turbines located in the hinterland between the established resident breeding population.

10.(ii).325 Over the two-year baseline study for the proposed wind farm site, golden eagle flight activity through the 500 m turbine buffer was recorded on 16 dates (19 observations) and involved several different birds including adults and sub-adults. Foraging/hunting behaviour was noted, especially along the upper southern slopes of Aghla Mountain above the turbine envelope; and some of the observations were thought to involve birds from the established pair in the Blue Stacks patrolling the boundaries of their home range. During VP watches golden eagles were recorded flying within the 500 m turbine buffer for 4,729 seconds, with 3,657 seconds judged to be at heights within the collision risk zone, and the remaining time (1,072 secs.) accounted for by flights above 150 m. Based on observed flight activity within the 500 m turbine buffer, the worst-case scenario collision risk (weighted and applying avoidance rate) was predicted to be 1.7 collisions over 30 years, equivalent to 1 bird every 17.3 years. Using this predicted collision rate a crude estimate of

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153 Ruddock, M. & Whitfield, D. (2007). *A review of disturbance distances in selected bird species*. A report from Natural Research (Projects) Ltd to Scottish Natural Heritage

154 Hunt G (2002). *Golden Eagles in a perilous landscape: predicting the effects of mitigation for wind turbine blade- strike mortality*. California Energy Commission. Predatory Bird Research Group, University of California, Santa Cruz. Contract No. 500-97-4033

155 O'Donoghue, B.G., Casey, M.J., Malone, E., Carey, J.G.J, Clarke, D. & Conroy, K. (2020) Recording and Addressing Persecution and Threats to Our Raptors (RAPTOR): a review of incidents 2007–2019. *Irish Wildlife Manuals*, No. 126. NPWS, Department of Housing, Local Government and Heritage, Ireland.

additional annual mortality resulting from direct operational impacts was generated by assuming an Irish golden eagle population of 20-25 birds (IRSG – 2017 Annual Review) that experiences annual survival rates of 0.95 for adult eagles (birds > 4 years old) and 0.15 for sub-adults (BTO)[156]; and accounting for potential demographic permutations, for example:

- 12 adults & 8 sub-adults — 12 adults & 13 sub-adults
- 10 adults & 10 sub-adults — 10 adults & 15 sub-adults
- 18 adults & 6 sub-adults — 10 adults & 6 sub-adults

10.(ii).326 In a worst-case scenario, if 18 adult birds were subject to a predicted collision rate of 0.06 collision per year, the potential for direct impacts with turbines would contribute to an additional *c*. 7% on annual background mortality. Due to low survivorship of sub-adult birds, projected additional mortality resulting from direct impacts remains below 1% for this demographic. Based on Percival (2003) a population effect of 6-20% is classed as *moderate*, which for a *high* sensitivity species would generate a potential direct impact of *high significance*.

10.(ii).327 However, Walker *et al.* (2005) investigating the ranging behaviour of a pair of golden eagle pre- and post-construction of wind farm in Argyll, Scotland, suggested that the pair changed their ranging behaviour to avoid the wind farm site. However, the shift in behaviour may have been compounded by the provision of compensatory habitat post-construction, which was observed to attract the resident pair. Birds did still, fly through the airspace of the wind farm and this appeared to be in response to other eagles impinging into the territory of the resident pair.

10.(ii).328 *In press* research analysing the satellite tracking data from 116 tags fitted on dispersing birds in Scotland, as summarised in Fielding *et al*., (2019)[157]; found that tagged birds were avoiding active wind turbines, with the results demonstrating macro-avoidance of operational wind farms sites. Fielding *et al*., (2019) suggest that macro-avoidance is likely to "*explain the very small number of recorded collisions between golden eagles and wind turbines in Scotland, despite considerable prospective overlap in the activities of eagles and wind farm distributions*"; and in this respect it is important to note the scale of the study area, which encompassed 236 wind farms (3,282 turbines). This study has subsequently been published, see Fielding *et al.* (2021)[158] for peer reviewed paper.

10.(ii).329 If the Scottish experience is transferable to Ireland, then displacement of golden eagles due to wind farm infrastructure, rather than collision risk, may present a more significant impact resulting from

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156 BTO BirdFacts https://app.bto.org/birdfacts/results/bob2960.htm - Robinson, R.A. (2005) *BirdFacts: profiles of birds occurring in Britain & Ireland*. BTO, Thetford (http://www.bto.org/birdfacts, accessed on 10 Jan-2021)

157 Fielding, A., Haworth, P.F., Anderson, D., Benn, S., Dennis, R., Weston, E., Grant, J., Etheridge, B. & Whitfield, D.P. (2019). *Responses of satellite tagged golden eagles to wind farms in Scotland: macro-avoidance rather than risk of collision*. Abstract for CWW Conference on Wind Energy and wildlife Impacts, University of Stirling: 27th to 30th August 2019

158 Fielding, A.H.; Anderson, D.; Benn, S.; Dennis, R.; Geary, M; Weston, E.; & Whitefield, D.P. (2021). Responses of dispersing GPS-tagged Golden Eagles (*Aquila chrysaetos*) to multiple wind farms across Scotland. *IBIS*

wind farm developments in upland areas. Obviously, the footprint of the proposed wind farm will result in a certain amount of direct habitat loss; however, the displacement of operational wind turbines has the potential to make larger areas unavailable to foraging birds.

10.(ii).330 Haworth *et al.*, 2006[159] (in Hardey *et al.*, 2009[160]) radio tracking golden eagles found that golden eagle home ranges in Scotland are between 846 ha and 6,687 ha. Assuming that all the habitat within the 500 m turbine buffer (389 ha) of the proposed wind farm site is optimal golden eagle foraging habitat and that birds exhibit total avoidance of the turbine envelope out to 500 m, then this equates to a displacement effect range from 6% to 46%. The fragmented nature of upland habitats in Co. Donegal and resultant variable quality of potential golden eagle foraging habitat, is summarised succinctly by The Golden Eagle Trust based on conducting live-prey transects which indicated *"that live prey numbers (primarily hare, grouse and rabbit) are quite varied with apparent 'hot spots' within a mosaic of poorer areas"* (IRSG, 2016 - Annual Review). Assuming a patchiness in habitat quality, it is likely that golden eagle home ranges will be at the larger end of the scale and the effect of displacement, in terms of relative size would be lower. As assessed in the baseline study (see **Section 10(ii) 4.3.4**, paragraphs 10.(ii).155, 10.(ii).164) the habitat quality within the wind farm site was considered relatively poor for golden eagle, with limited cover for prey species and the occurrence conifer plantation throughout.

10.(ii).331 Based on relatively low observed usage of the wind farm site by foraging golden eagles and occurrence of sub-optimal forging habitats (plantations) it is considered that the effect of potential displacement due operational turbines will have a *negligible* effect on the regional population and therefore is *not significant.*

10(ii) 5.3.3.6 Whooper swan – Potential operational phase impacts

10.(ii).332 The footprint of the operational wind farm will not result in the direct loss of foraging or roosting habitat used by whooper swans. All recorded usage in the wider area by foraging or roosting birds was > 2 km from the proposed wind farm site, which is beyond the 600 m '*zone of sensitivity*' to operational wind farm delineated in McGuiness *et al.* (2015)[161] for this species. Therefore, it is considered that there will be no disturbance or displacement effect on a small wintering whooper swan population utilising the wider area.

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159 Haworth, P.F, Mcgrady, M.J.,Whitfield, D.P., Fielding, A.H. & McLeod, D.R.A. (2006) Ranging distance of resident Golden Eagles *Aquila chrysaetos* in western Scotland according to season and breeding status. *Bird Study*. 53:3, 265-273

160 Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. & Thompson, D. (2009). *Raptors: a field guide for surveys and monitoring*. 2nd Ed. Stationery Office, Edinburgh.

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

10.(ii).333 Based on observed usage of the wind farm site it can be excepted that once the wind farm becomes operational there may be the occasional disruption to whooper swans flying through the area on passage, including the risk of colliding with the turbines. Acknowledging the limitations to survey effort over the spring-2020 passage window, usage of the 500 m turbine buffer was limited to infrequent flight lines of small flocks (3 to 23 birds) on passage in autumn (3 flight lines in Oct-2018 and 1 flight line in Oct-2019) and spring (2 flight lines in Mar-2019). VP watch data generated 7,148 seconds of flight line data within the 500 m turbine buffer, all of which was determined to be at collision risk height. Flights recorded ranged in height from 30 to 150 m, with all observations noted as commuting birds on passage. Based on observed flight activity within the 500 m turbine buffer over the winter, the collision risk (weighted and applying avoidance rate) was predicted to be low, 0.76 collisions over 30 years, equivalent to 1 collision every 39.7 years. This level of mortality would be below background rates and would have an imperceptible impact on whooper swan populations wintering in Ireland.

10.(ii).334 The CRM was re-run to only account for survey effort and a flight period during spring/autumn passage only (not the whole winter survey period), including 25% allowance for night flights. In compensating for the limitations to coverage over spring-2020, it was assumed that movement would be equivalent to the previous spring (i.e. a diffuse level of passage migration involving small numbers) and spring-2020 was attributed the equivalent flight time as spring 2019. As would be expected by running a more sensitive model predicted mortality increased, and depending on different permutations used to account for flight time, resulted in predictions of 1 collision every 12 to 23 years, which remains well below background rates of mortality rates.

10.(ii).335 Given the *Medium* conservation sensitivity of whooper swans, the *negligible* magnitude of the impact (max. one collision every 12 years, estimated to affect 0.07% of the RoI wintering population); it is considered that the potential direct impact of collision risk on whooper swans is *not significant*.

10(ii) 5.3.3.7 Red grouse – Potential operational phase impacts

10.(ii).336 As discussed in **Section 10(ii) 5.3.2.7**, research suggests local red grouse populations may suffer some displacement during construction (Pearce-Higgins *et al.*, 2012[162]); however, post-construction numbers recover and operational wind farms are generally considered to have a neutral impact on red grouse (Pearce-Higgins *et al.*, 2009[163]; Douglas *et al.*, 2011[164]). The footprint

162 Pearce-Higgins, J.W., Stephen, L., Douse, A. & Langston, R.H.W. (2012). Greater impacts of wind farms on bird populations during construction than subsequent operation: results of a multi-site and multi-species analysis. *Journal of Applied Ecology*, 49, 386–394

163 Pearce-Higgins, J.W., Stephen, L., Langston, R.H.W., Bainbridge, I.P. & Bullman, R. (2009). The distribution of breeding birds around upland wind farms. *Journal of Applied Ecology*, 46, 1323–1331.

164 Douglas, D.J.T., Bellamy, P.E. & Pearce-Higgins, J.W. (2011). Changes in the abundance and distribution of upland breeding birds at an operational wind farm. *Bird Study*, 58, 37–43.

of the operational wind farm avoids suitable red grouse nesting cover. In addition, while not totally immune to collisions with turbines, especially where the rotor swept zone extends below 20 m, red grouse with their predominately ground based existence, high fecundity and short, low flights means they exhibit low vulnerability to collision. Therefore, with consideration given to the *medium* population sensitivity and the neutral to *negligible* the magnitude of effects; the potential direct and indirect impacts during the operational phase of the proposed wind farm on foraging and breeding red grouse are considered *not significant.*

10(ii) 5.3.3.8 Peregrine – Potential operational phase impacts

10.(ii).337 Wind turbine represent a potential collision risk to peregrines and at this location the operational wind farm has the potential to exert a level of displacement on birds foraging through the area. No impacts are anticipated for breeding peregrines, as there were no breeding sites located within 2 km of the proposed wind farm and the availability of suitable nesting cliff was assessed as limited. Over the two-year study only two peregrine flight lines were recorded within the 500 m turbine buffer during VP watches and both flight lines were below the collision risk zone. Therefore, based on low usage is objectively considered that any potential collision risk or displacement effects on foraging birds caused by the operational wind farm will be of *negligible* magnitude and therefore *not significant.*

10(ii) 5.3.3.9 Golden plover – Potential operational phase impacts

10.(ii).338 Over the two study years golden plover were only observed on passage three times. All records were of birds detected beyond the 500 m turbine buffer. Taking account of the low levels of flight activity, the *negligible* effects and the *medium* conservation sensitivity of the species, in terms of collision risk, the potential impact of the proposed wind farm on golden plover is considered to be *not significant.*

10(ii) 5.3.3.10 Red listed breeding passerines – Potential operational phase impacts

10.(ii).339 Three BoCCI Red listed species were recorded within the 500 m turbine buffer, including whin chat, meadow pipit and grey wagtail.

10.(ii).340 Information on the effects of operational wind farms on small passerine birds is limited compared to studies on larger collision risk species, such as eagles and hen harriers. Some studies find limited effects of active turbines on passerine assemblages (e.g. Devereux *et al.* 2008)[165], with other

165 Devereux, C. L., Den`ny, M. J. H. & Whittingham, M. J. (2008). Minimal effects of wind turbines on the distribution of wintering farmland birds. *Journal of Applied Ecology* 45: 1689-1694.

reporting mild to moderate displacement effects (e.g. Wilson *et al.*, 2015[166] & Pearce-Higgins *et al.*, 2012[167]). A study by Gómez-Catasús *et al.*, (2018)[168] investigating the effects of wind farms on a threatened passerine (Dupont's lark) suggests that wind farms can have a significant and deleterious impact, with a magnitude of annual decline four times higher than for similar populations occurring in control areas without wind turbines.

10.(ii).341 Whinchat are a notably rare breeding species in Ireland and two pairs were recorded breeding in the vicinity of Graffy Bridge. There is potential for an inappropriately designed wind farm to result in loss of habitat for this species and for operational disturbance to result in displacement of this regionally important breeding site. As embedded mitigation, a nineth turbine was dropped from the final layout and exclusion of this turbine limits activity closer to the Stracashel River, avoiding the potential for directly impacting on breeding whinchat and also avoiding the loss of suitable wet grassland used by the species for nesting.

10.(ii).342 The area of suitable nesting habitat is located in wet grassland along the Stracashel River and will be > 200-250 m from T8. Although whinchat do nest in upland heath, it is considered unlikely that these birds will re-locate closer the proposed wind farm infrastructure, as suitably dense heather cover is limited. The area of wet grassland is at the base of the valley and will be significantly lower than the position of T8. This gradient, height difference, several treelines and the existing local road are likely to extenuate the effects of any potential disturbance factors emanating from the closest turbine (T8). Given the regional importance of these pairs, a degree of uncertainty as to whether a standoff 200-300 m is sufficient to limit disturbance effects and based on a *low* to *moderate* magnitude of effect (> 1% effect on national population) and *medium* species sensitivity, the potential impact was considered to be of *low significance*, requiring appropriate mitigation.

10.(ii).343 Meadow pipit were a common and widespread species throughout areas of open bog and unimproved of acid grassland within the wind farm site. Pearce-Higgins *et al.* (2012)[169] suggest positive effects for breeding densities for meadow pipits on wind farm site post-construction related to changes in vegetation structure improving nesting opportunities. Therefore, operational impacts on breeding meadow pipit are considered neutral and *not significant*.

10.(ii).344 Baseline studies identified that the streams within the wind farm site, including a limited stretch of steeper side rocky river bank with nesting habitat supported a single pair of grey wagtails. Nest

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166 Wilson, M, Fernández-Bellon, D., Irwin, S. & O'Halloran, J. (2015). *The interactions between Hen Harriers and wind turbines*. Windharrier. Final project report, prepared by School of Biological, Earth & Environmental Sciences, University College Cork, Ireland.

167 Pearce-Higgins, J.W., Stephen, L., Douse, A. & Langston, R.H.W. (2012). Greater impacts of wind farms on bird populations during construction than subsequent operation: results of a multi-site and multi-species analysis. *Journal of Applied Ecology*, 49, 386–394

168 Gómez-Catasús, J., Garza, V. & Traba, J. (2018). Wind farms affect the occurrence, abundance and population trends of small passerine birds: The case of the Dupont's lark. *Journal of Applied Ecology* 55(40: 2033-2042

169 Pearce-Higgins, J.W., Stephen, L., Douse, A. & Langston, R.H.W. (2012). Greater impacts of wind farms on bird populations during construction than subsequent operation: results of a multi-site and multi-species analysis. *Journal of Applied Ecology*, 49, 386–394

habitat will not be affected by construction of the wind farm and there will be *c*. 150 m standoff from potential nesting locations and the closest section of site infrastructure around T2. It is anticipated that there will be no disturbance or displacement of breeding birds due to operational activities. However, grey wagtails are reliant on good water quality to support the aquatic invertebrates they forage on. Inappropriately, designed and constructed wind farm infrastructure has the potential to impact on water quality. Therefore, in the absence of appropriate control measure, deterioration of water quality related to wind farm construction has the potential to impact on foraging opportunities of a single pair utilising the wind farm site. At a population level any potential operational effects on grey wagtails will have *negligible* effect and are therefore considered *not significant*.

10(ii) 5.3.3.11 Sparrowhawk – Potential operational phase impacts

10.(ii).345 As discussed in **Section 10(ii) 5.3.2.12**, it is considered that the construction of the wind farm will result in the displacement of a pair sparrowhawk at T1, which if assessed in terms of the local population returned an impact of *very low significance*. The displacement effect of the project will remain once the turbines are operational; however, given the abundance of alternative nesting cover in the surrounding plantations the effect is considered *negligible* and therefore *not significant*. Likewise, secondary impacts due to displacement of foraging birds or displacement of prey species from areas around the operational wind farm is considered *not significant*.

10.(ii).346 Despite the presence of a breeding pair in the 500 m turbine buffer, sparrowhawks were only recorded flying within the buffer for 757 seconds during VP watches, with only 291 seconds judged to be at heights within the collision risk zone. Based on observed flight activity within the 500 m turbine buffer, the collision risk (weighted and applying avoidance rate) was predicted to be 0.25 collisions over 30 years, equivalent to 1 bird every 118 years.

10.(ii).347 As reviewed in Madder & Whitfield (2006)[170] relying on VP watch data and the resultant CRMs may not be an appropriate methodology for assessment of collision risk in a small raptor species like sparrowhawk. This species spends a high proportion of the time utilising cover, typically employing low hunting flight behaviour to ambush prey, which means a certain amount of the flights are likely to go undetected behind vegetation or other features. The fact that the majority of sparrowhawk flights are considered to be low level (< 20 m) inherently reduces the likelihood of collision for this species. However, higher display/territorial flights are observed during the breeding season and there may be a seasonal increase in collision risk for this species. A relatively

170 Madder & Whitfield (2006). Upland raptors and the assessment of wind farm impacts. *IBIS* 148:1 43-56

small number of sparrowhawk fatalities have been reported from Irish wind farm sites (e.g. Cullen & Williams 2010)[171]

10.(ii).348 Based on low levels of predicted collision risk for sparrowhawk and on the proviso that lowest extent of the rotor swept volume remains > 20 m, it is considered that the magnitude of effect is *negligible*. Therefore, for a population of *Low* sensitivity, the potential impact due to collision risk from turbines is considered be *not significant*.

10(ii) 5.3.3.12 Kestrel – Potential operational phase impacts

10.(ii).349 During VP watches kestrels were one of the most frequently detected species within the 500 m turbine buffer. Overall flight time within the 500 m turbine buffer was 3,811 seconds, with 3,014 seconds recorded at heights within the rotor swept area; of which 706 seconds (6 observations) were attributed to year one, with year two generating significantly higher flight activity registering 2,308 seconds (16 observations). Within the wind farm site, the mosaic of different habitats creates lots of edge effects which can be exploited by foraging kestrels. There are breeding options within the wind farm site; however, the closest active nest site identified during the baseline study was *c.* 1 km from the closest proposed turbine.

10.(ii).350 Flight behaviour means kestrels are a species emerging as notably susceptible to collision with turbines and this is acknowledged within the collision risk model, which is run with a lowered avoidance rate for kestrel (95% avoidance rate). Based on observed flight activity within the 500 m turbine buffer, the collision risk (weighted and applying avoidance rate) was predicted to be 5.01 collisions over 30 years, equivalent to 1 bird every 6 years. Despite declining numbers, kestrel remain a common and widespread raptor in Ireland (9,918-17,393 pairs in Lewis *et al.* 2019)[172] and on a country wide population basis this magnitude of effect on a single pair would be considered *negligible*. If considering the magnitude of the effect on local kestrel populations (e.g. 6 birds within 10 km) then the magnitude would be assessed as *low* (*c.* 1-5% of local population affected).

10.(ii).351 Foraging and possibly breeding kestrel do not appear to be suffer displacement effects from operational turbines, which combined with flight behaviour may explain the higher levels of collision. Generally, kestrels would be considered a species that becomes habituated to human activity; for instance, birds regularly nest in active quarries; and at one wind farm site, Woodrow surveyors located a pair of kestrels using a hooded crow nest in a treeline of Sitka spruce, which

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171 Cullen, C. & Williams, H. (2010). Sparrowhawk *Accipiter nisus* mortality at a wind farm in Ireland. *Irish Birds*, 9: 125-126

172 Lewis, L. J., Coombes, D., Burke, B., O'Halloran, J., Walsh, A., Tierney, T. D. & Cummins, S. (2019a) Countryside Bird Survey: Status and trends of common and widespread breeding birds 1998-2016. *Irish Wildlife Manuals*, No. 115. NPWS, Department of Culture, Heritage and the Gaeltacht, Ireland.

was located *c*. 95 m for a turbine tower. Often post-construction habitat within wind farm sites, e.g. felled areas, tracks and habitat management areas, creates good foraging habitat for kestrels and may actively attract birds into the wind farm site, increasing the potential for collisions to occur.

10.(ii).352 Overall, as an amber listed species kestrel are classed as *low* sensitivity at this locality (upgraded to *Medium* based on recent assignment to the BoCCI4 (2020-2026) Red list); and in view of predicted collision risk acting at a local level, it is considered that the direct effects of the operational wind farm will be *low*, resulting in an impact of *very low significance* to *low significance* on the local population. Any potential secondary impacts are considered *not significant*.

10(ii) 5.3.3.13 Snipe – Potential operational phase impacts

10.(ii).353 The baseline study identified 2-3 snipe territories within the wind farm site and the area was not found to be an important wintering area for this species. Direct loss of any substantial areas of breeding/wintering habitat are not anticipated, as the site layout avoids potential snipe habitat on wetter parts of the hill. The potential displacement effects on wintering snipe due to the operational wind farm have been assessed as likely to be imperceptible, based on the low densities of wintering birds recorded and the marginal quality of wintering wetland habitats available within the proposed wind farm site relative to wetland habitats beyond the zone of influence.

10.(ii).354 The cryptic nature of snipe means that population estimates derived for both wintering and breeding birds are based on expert opinion, with the RoI population estimated at 4,275 pairs (BWI, 2010) and in 2013 the NI population was estimated at 1,123 pairs (Colhoun *et al.* 2015 - see also Henderson *et al.*, 2002). The wintering population is bolstered by a significant influx of overwintering European birds. While both the wintering and breeding populations are BoCCI Red listed, there are unrestricted bag limits on taking wintering snipe, suggesting there is less concern with this component of the population.

10.(ii).355 Fatalities due to turbine collisions are reported (Hötker *et al*, 2006[173] & Fennelly, 2015[174]), and breeding snipe may be at higher risk of collision, due to the flight behaviour of territorial (drumming) birds. During baseline VP watches there were no flight lines recorded over winter and just three flight observations during the breeding season, amounting to 1,327 seconds at rotor swept height within the 500 m turbine buffer. For snipe, a species known to fly at night, a correction of 25% was applied to account for potential nocturnal flight time and the model was run to account

173 Hötker, H., Thomsen, K.M. & Jeromin, H. (2006). Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats - facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation. Michael-Otto-Institut im NABU, Bergenhusen.

174Fennelly, R.F. (2015). A Review of Bird Strike Mortality at Irish Onshore Windfarms. *CIEEM in-practice* Issue 88 June 2015 for breeding season flight time only. For species where no avoidance rates have been estimated, SNH (2018)[175] recommend applying a rate of 98%. Predicted collision risk (weighted and applying avoidance rate) was estimated to be low at 1.29 collisions over 30 years, equivalent to one bird every 23.3 years.

10.(ii).356 However, as reviewed in Madder & Whitfield (2006)[176] relying on VP watch data and the resultant CRMs may not be an appropriate methodology for assessment of an elusive species like snipe, as flight time can be underestimated. It is estimated that to have a perceptible effect on the Irish breeding population (i.e. > 1% than background mortality), Irish wind farms cumulatively would have to result in direct impacts on 5,000-6,000 snipe per annum. While acknowledging the inherent uncertainties surrounding predicted collision rates and population estimates for snipe, the magnitude of effect at the population level for collision risk is *negligible*. Therefore, in view of *Low* (even when upgraded to *Medium* based on recent upgrading to Red list) population sensitivity (Percival, 2003), the potential direct operational phase impacts on snipe winter and breeding within the proposed wind farm site is considered *not significant*.

10.(ii).357 Pearce-Higgins *et al.* (2009) suggests that breeding snipe densities may reduce by up to 47.5% within 400 m of operational turbines. Therefore, there is a risk that once operational the wind farm will display 1-2 snipe territories identified in the bog above T5, T6, T7 (on Graffy Hill), which fall within a 400 m buffer zone from proposed turbine locations. An area of potential snipe habitat and a small number of territories identified on the south side of the L-6743 secondary local road are within 400 m of T4/T5.

10.(ii).358 Given the *Low* conservation sensitivity of snipe ,the relatively small numbers of pairs (2-3 pairs) and wintering birds potentially impacted at this location, it is considered that the spatial magnitude of effect is *negligible*. However ,accounting for the *long term* (25-30 years) temporal magnitude of the disruptive effects on breeding snipe, as well as cumulative impacts of other activities in the area (e.g. agroforestry and land drainage), the potential indirect impact of the operational wind farm on breeding snipe is assessed as a *Low* magnitude effect; and therefore, of *very low significance*, possibly requiring mitigation in the form of compensatory measures. The potential impacts from the operational wind farm on the wintering population is considered *not significant*

10(ii) 5.3.3.14 Jack snipe – Potential operational phase impacts

10.(ii).359 As part of widespread a relatively numerous Irish wintering population, a small number of Jack snipe are likely to utilise wetter habitats within the proposed wind farm site over winter and on

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

176 Madder & Whitfield (2006). Upland raptors and the assessment of wind farm impacts. *IBIS* 148:1 43-56

passage. This species does not breed in Ireland, therefore there will be no direct effects on breeding sites, due to habitat loss resulting from the operational footprint of the proposed wind farm site. Likewise, direct loss of any substantial areas of wintering habitat are not anticipated, as the site layout avoids wetter parts of the hill. The effects of disturbance on wintering jack snipe for operational wind turbines is unknown, however this species is likely to behave in a similar way to common snipe and there may be some localised displacement of birds utilising the areas around operational turbines (up to 400 m as found for common snipe in Pearce-Higgins *et al.* 2009)[177].

10.(ii).360 Given the low importance of the proposed wind farm's site as a wetland habitat for wintering waterbirds, the low levels of recorded usage within the 500 m turbine buffer and the *Low* population sensitivity, the magnitude of any effects are considered *negligible*; and therefore, the potential impacts of the operational wind farm on Jack snipe are classed as *not significant*.

10(ii) 5.3.3.15 Amber listed breeding passerines – Potential operational phase impacts

10.(ii).361 There were nine species of BoCCI Amber listed breeding passerines that were recorded breeding within the wind farm site, including: goldcrest, mistle thrush, robin, skylark, spotted flycatcher, starling, stonechat, swallow and wheatear. One non-breeding BoCCI Amber listed species, house martin was recorded foraging within wind farm site and are likely to be breeding adjacent to the site. The only other small, non-breeding Amber listed species recorded were swift (not a passerine) which occasionally foraged through the area in small numbers.

10.(ii).362 Globally post-constructions turbine searches have recovered a wide range of passerines causality suffering direct impacts from operational turbines. The species or very similar species recorded at Graffy have all been documented as victims. Generally, passerines are considered to exhibit low levels of sensitivity to ongoing operational disturbance at wind farms and where detected, effects are typically of limited extent only exerting an influence over 100–200 m (as reviewed in Pearce-Higgins *et al.*, 2012)[178]. The high productivity of most passerine species means that populations are not likely to be affected to any significant degree by collisions with turbines. In addition, many of the species moving through the site, especially scrub and woodland nesting birds are likely to be doing so at an altitude below collision risk height. Conversely, based studies employing radar and observer effort passerines on migration flight tend to be undertaken at heights above the collision risk zone especially overnight and when confronted with turbine arrays during the day

177 Pearce-Higgins, J.W., Stephen, L., Langston, R.H.W., Bainbridge, I.P. & Bullman, R. (2009). The distribution of breeding birds around upland wind farms. *Journal of Applied Ecology*, 46, 1323–1331.

178 Pearce-Higgins, J.W., Stephen, L., Douse, A. & Langston, R.H.W. (2012). Greater impacts of wind farms on bird populations during construction than subsequent operation: results of a multi-site and multi-species analysis. *Journal of Applied Ecology*, 49, 386–394

birds have been observed employing marco-avoidance (e.g. Blew *et al*, 2008[179], Krijgsveld *et al.*, 2011[180], Lindeboom *et al.*, 2011[181]).

10.(ii).363 Breeding densities of some species (as discussed for meadow pipits) were found by Pearce-Higgins *et al.* (2012) to exhibit potential positive effects of wind farm construction including species nesting in more open habitats like skylarks and stonechats; although data suggested that wheatear may exhibit a degree of turbine avoidance. The findings of Pearce-Higgins *et al.* (2012) contrast somewhat to those Fernández-Bellon *et al.* (2018)[182] who suggest based on studying bird populations at Irish windfarms, that large wind farms held lower densities of open-habitat species such as meadow pipit, skylark and wheatear. However, the study lacked the pre-construction comparative surveys employed in Pearce-Higgins *et al.* (2012).

10 .(ii).364 In terms of mechanisms of effect, research on Portuguese wind farms found that breeding skylarks were the species with the highest overall mortality in heathland habitats; and suggested this was related to the display flights undertaken by male skylarks, which increases susceptibility to collision risk (Morinha *et al.*, 2014)[183]. This finding was based on spring turbine searches conducted at 9 wind farms (82 turbines), with *c.* 100 search visits (*c.* 900 turbine searches) generating 22 skylark carcasses. The authors used factors to correct for searcher efficiency and carcass removal rates by scavengers to provide a figure for 'real mortality'. This was found to be of a higher order of magnitude (225 collisions) and was considered capable of having long-term impacts on demographics (*c.* 90% of birds killed were male) and abundance.

10.(ii).365 Utilising this data set Bastos *et al.* (2016)[184] ran populations models for northern Portuagal, which showed that the average local impact for collision on breeding skylark would increase over time, i.e. as the local population declines due to effects driven by a range of environmental factors (such climate change) the magnitude of effect on the local breeding pairs increases due to turbine mediated mortality. The modelling predicted that direct impacts from operational wind farms on the local breeding populations would increase from 1.3%/km^2 in 2006 to 4%/km^2 in 2026.

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179 Blew, J., Hoffman, M., Nehls, G. & Hennig, V. (2008). Investigations of the bird collision risk and the responses of harbour porpoises in the offshore wind farms Horns Rev, North Sea, and Nysted, Baltic Sea, in Denmark. Part I: Birds. Universität Hamburg and BioConsult SH Report.

180 Krijgsveld, K.L., Fijn, R.C., Japink, M., van Horssen, P.W., Heunks, C., Collier, M.P., Poot, M.J.M. & Dirken, S. (2011) Effect studies Offshore Wind Farm Egmond aan Zee: Final report on fluxes, flight altitudes and behaviour of flying birds. Bureau Waardenburg report no. 10-219. Commissioned by NordzeeWind

181 Lindeboom, H.J., Kouwenhoven, H.J., Bergman, M.J.N., Bouma, S. Brasseur, S., Daan, R., Fijn, R.C., de Haan, D., Dirksen, S., van Hal, R. Hille Ris Lambers, R., ter Hofstede, R., Krijgsveld4, K.L., Leopold, M. & Scheidat, M. (2011). Short-term ecological effects of an offshore wind farm in the Dutch coastal zone; a compilation. *Environ. Res. Lett.* 6: 1-13

182 Fernández-Bellon, D., Wilson, M.W., Irwin, S. and O'Halloran, J. (2018). Effects of development of wind energy and associated changes in land use on bird densities in upland areas. *Conservation Biology* 33(2): 413-422.

183 Morinha, F., Travassos, P., Seixas, F., Martins, A., Bastos, R., Carvalho, D., Magalhães, P., Santos, M., Bastos, E. & Cabral, J. A. (2014). Differential mortality of birds killed at wind farms in Northern Portugal. *Bird Study* 61, 255-259.

184 Bastos, R., Pinhanços, A., Santos, M., Fernandes, R.F., Vicente, J.R., Morinha, F., Honrado, J.P., Travassos, P., Barros, P. & Cabral, J. A. (2016). Evaluating the regional cumulative impact of wind farms on birds: how can spatially explicit dynamic modelling improve impact assessments and monitoring? *Journal of Applied Ecology*, 53, 1330-1340

Accounting for all the wind farms in the region, the modelling also generated predicted regional cumulative impacts which increased from 1.2% to 3.7% of the total estimated breeding individuals. Based on Percival (2003) this magnitude of effect on either the local or the regional population would be classed as *Low* (1-5% of population affected).

10.(ii).366 For woodland and scrub nesting species, it is acknowledged that vegetation clearance to facilitate construction will alter habitat availability and the operational footprint of the wind farm will result in a localised displacement of breeding birds.

10.(ii).367 The amber listed species, as with the majority of the passerines recorded within the wind farm site are considered relativity abundant and widespread species (Crowe *et al*., 2014[185] & Lewis *et al.* 2019a[186]), which have high reproductive rates with populations that are unlikely to be affected to any degree by the operational wind farm, and the magnitude of the effect would be classed as *negligible* on a populations of *low* sensitivity and therefore impacts on amber listed passerines during the operational phase of the project are considered to be *not significant*. For skylark where the direct/indirect impacts of operational turbines on local populations have the potential for a *Low* magnitude of effect the impacts are considered to be of *very low significance*.

10(ii) 5.3.3.16 Buzzard – Potential operational phase impacts

10.(ii).368 Buzzards were the most commonly recorded target species over the baseline study, with 33 observations recorded within the 500 m turbine buffer during VP watches, which generated a relatively high number of flight seconds (8,011 seconds). A high proportion of flight time (92%) was recorded within the collision risk zone.

10.(ii).369 Pearce-Higgins *et al.* (2009)[187] suggest that buzzards showed reduced flight activity and avoided an area of 500 m around turbines. This displacement effect may be pronounced immediately after construction and in the first few years of the operational phase. However, it is emerging that some species (including buzzard) develop tolerance to active turbines over time, which may result in a lag time of 2-3 years in the manifestation of post-construction collision related fatalities. Surveyors from Woodrow monitoring active wind farm sites across Ireland have identified several pairs nesting in close proximity to turbines, the closest occupying a small linear oak-hazel woodland within 190 m of a turbine. Clearly nesting near turbines carries an increased collision risk (especially for young recently fledged birds that are mastering their power of flight and likely to

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185 Crowe, O., Musgrove, A.J. & O'Halloran, J. (2014). Generating population estimates for common and widespread breeding birds in Ireland. *Bird Study* 61(1): 82-92

186 Lewis, L. J., Coombes, D., Burke, B., O'Halloran, J., Walsh, A., Tierney, T. D. & Cummins, S. (2019a) Countryside Bird Survey: Status and trends of common and widespread breeding birds 1998-2016. *Irish Wildlife Manuals*, No. 115. NPWS, Department of Culture, Heritage and the Gaeltacht, Ireland

187 Pearce-Higgins, J.W., Stephen, L., Langston, R.H.W., Bainbridge, I.P. & Bullman, R. (2009). The distribution of breeding birds around upland wind farms. *Journal of Applied Ecology*, 46, 1323-1331.

be naïve to the threats posed by turbines) and two buzzard fatalities (uncorrected for scavenger removal/observer rates) were attributed to collisions with turbines over four years of post-construction monitoring at the wind farm mentioned above.

10.(ii).370 Increasingly, as post-construction monitoring programmes improve, buzzards are a species emerging as notably susceptible to collision with turbines and this is acknowledged within the collision risk model, which is run with a lowered avoidance rate (98% avoidance rate). Based on observed flight activity within the 500 m turbine buffer, the collision risk (weighted and applying avoidance rate) was predicted to be 5.8 collisions over 30 years, equivalent to 1 bird every 5.2 years.

10.(ii).371 The buzzard population in Ireland has increased exponentially over the last 20 years and is still expanding into new areas; seemly only limited by the availability of nesting habitat, typically in trees (Lusby, 2011[188], Balmer *et al.* 2013[189]). The success of buzzards in Ireland can be attributed to a notably high fecundity for a raptor (capable of fledging broods of 6 young); and the species' ability to exploit numerous food sources, ranging from carrion, worm and larger more mobile prey items like rabbits. Buzzards also employ a variety of foraging techniques (e.g. sitting in tree or active hunting flights), depending on habitat, seasonality and prey types, which has allowed them to expand into a wider range of ecological niches when compared to other raptors. Although no population estimate is available for buzzards in Ireland, as indicated by the BoCCI Green listing the species is now a common and widespread raptor in Ireland. Therefore, on a country wide population basis the magnitude of effect from direct and indirect operational impacts would be considered *negligible* and at the population level are considered *not significant*.

10(ii) 5.3.3.17 Wintering woodcock – Potential operational phase impacts

10.(ii).372 Records of woodcock were limited to wintering birds, which utilise the forestry/scrub within the wind farm site to roost up during the day and are likely to forage in the bog/wet acid grassland during the night. The wintering and breeding populations are considered to be different, with only the declining breeding population being BoCCI Red listed; therefore, at this location, wintering woodcock populations are classed as not being sensitive to proposed wind farm developments (Percival, 2003).

188 Lusby, J. (2011). Species Focus: Buzzard comeback – Numbers continue to soar. *Wings* Spring 2011, BirdWatch Ireland publication.

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

10.(ii).373 There is evidence of operational turbines impacting on breeding woodcock and resulting in reduced display activity in roding males. As discussed in Dorka *et al.* (2014)[190], Schmal (2015)[191] and Straub *et al.* (2015)[192]; an 88% decline in territorial males was detected between pre-construction surveys and Year 1/Year 2 post-construction surveys. There are no published studies investigating the effects of operational wind farms on the wintering population. Surveyors from Woodrow deploying night recording cameras have (incidentally of the deployment) captured footage of woodcock flying into improved grassland to forage within 150 m of turbines. On another site a woodcock fatality, suspected of flying into a turbine was recovered during turbine searches. These examples illustrate as for many species, that while the effect of turbine displacement may be minimal, activity adjacent to turbines heightens the risk of collisions.

10.(ii).374 It is acknowledged that vegetation clearance (specifically felling operations around T1 and between T4 and T5 to facilitate construction of the wind farm) will alter habitat availability for day roosting woodcock. Therefore, the operational footprint of the wind farm will result in a localised displacement of wintering woodcock to adjacent areas of similar cover. Availability of cover is not considered to be a factor limiting the occurrence of this species at this location and any displacement effect will be imperceptible.

10.(ii).375 The Irish wintering population receives a massive influx of birds from continental Europe; and given the assumed stability of the population (e.g. there is no daily bag limit for woodcock in Ireland), the constrained nature of the operational wind farm and the fact that there is an abundance of alternative cover in the adjacent area means the magnitude of any operational effects are considered *negligible*. Therefore, the potential direct/indirect impacts on wintering woodcock during the operational phase of the project are considered to be *not significant*.

10(ii) 5.3.3.18 Non-breeding gulls – Potential operational phase impacts

10.(ii).376 As outlined by the results of the baseline study (**Section 10(ii) 4.3.13**), there was relatively low recorded usage of the 500 m turbine buffer by non-breeding gulls including: great black-backed gulls, lesser black-backed gulls and herring gulls (with one record of a single black-headed gull considered immaterial to the assessment). In addition, there is a lack of breeding sites in the vicinity of the wind farm site and the closest breeding colonies for these species are located more than

190 Dorka, U. Straub, V.F. & Trautner, J. (2014). Wind power above forest - Courtship of the woodcock at risk? Findings from a case study in Baden-Wuerttemberg (Northern Black Forest) *Naturschutz und Landschaftsplanung*, 46: 69-78

191 Schmal, V.G. (2015). Sensitivity of the woodcock to wind power plants – contribution to the current discussion. *Naturschutz und Landschaftsplanung*, 47: 43-48

192 Straub, V.F., Trautner, J. & Dorka, U. (2015). Woodcocks are sensitive to wind power plants, and their harming can break legislation on species protection – Reply to Schmal (2015) in the context of the publication by Dorka *et al.* (2014). *Naturschutz und Landschaftsplanung*, 47: 49-58

20 km away, i.e. beyond the zone of influence (Mitchell *et al.*, 2004[193] and Cummins *et al.*, 2019[194]).

10.(ii).377 The BoCCI listings for gulls (herring gull - red listed and lesser black-backed gulls/great black-backed gull – amber listed) are applicable to the breeding component of the population; therefore, as the gulls utilising the area were found to be non-breeding, it is appropriate to assess gulls at the lowest level of population sensitivity (Percival, 2003).

10.(ii).378 For great black-backed gulls, the heights for majority of flight lines through the turbine envelope (n = 6 obs.) were judged to be within the collision risk zone and aggregated amounted to 1,018 flight seconds. Predicted Collision risk (weighted and applying avoidance rate) was estimated to be low at 0.23 collisions over 30 years. The Irish breeding population is estimated at 3,081 pairs (Cummins *et al.*, 2019)

10.(ii).379 For Lesser black-backed gulls, the heights for the majority of flight lines through the turbine envelope (n = 10 obs.) were judged to be within the collision risk zone and aggregated amounted to 2,402 flight seconds. Predicted collision risk (weighted and applying avoidance rate) was estimated to be exceptionally low at 0.54 collisions over 30 years. The Irish breeding population is estimated at 7,112 pairs (Cummins *et al.*, 2019).

10.(ii).380 Herring gulls were observed to be the most numerous gull species recorded in the environs of the wind farm site, with a high proportion of sub-adult birds typically noted in flocks. Although, a relatively high combined flight time within the 500 m turbine buffer and at rotor swept height was recorded (19,395 flight secs.), this was driven by a single large flock (150 birds). The occurrence of herring gulls within the wind farm site was limited to four observations over the two years, with an additional observation of a mixed flock of gulls (60 birds) judged to be mostly immature herring gulls. Collision risk (weighted and applying avoidance rate) was estimated to be low at 4.09 collisions over 30 years. The Irish breeding population is estimated at 10,333 pairs (Cummins *et al.*, 2019)

10.(ii).381 For all three gull species the predicted level of mortality due to collision was found to be well below background rates and would have an imperceptible impact on gull populations. Therefore, the magnitude of effect on non-breeding gulls from the operational wind farm is considered *negligible* and any direct/indirect impacts are *not significant*.

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

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

10(ii) 5.3.4 Decommissioning Phase Impacts

10.(ii).382 Impacts associated with decommissioning are very much similar to those associated with the construction phase both in terms of duration, intensity and position. As with construction impacts the main concerns are likely to relate to disturbance during times when the species are most vulnerable, notably the breeding season. For this reason, it is recommended that works are timed to avoid the breeding season. Because decommissioning will not occur for some decades, there is a possibility that other bird species, not recorded during this survey may be in the area. Therefore, a pre-decommissioning bird survey should be undertaken with the specific objective of identifying any species of nature conservation importance that may be affected by the decommissioning phase and works timed accordingly to avoid sensitive periods.

10.(ii).383 Taking account of the species present at the site during baseline surveys, and considering the nature conservation importance of the species that make up the bird assemblage, the potential effect of decommissioning disturbance is no higher than *negligible* to *very low significance* for most of the avian species or assemblage present. The exceptions being where inappropriately phased/monitored works will result in disturbance to breeding merlin, whinchat, meadow pipit, snipe and BoCCI Amber listed passerines generating potential impacts of:

- *Medium significance*: for direct/indirect disturbance on breeding merlin
- *Low significance*: for indirect disturbance to breeding whinchat
- *Low significance*: for direct/indirect disturbance to ground nesting meadow pipit
- *Very low significance*: for direct/indirect disturbance to breeding snipe
- *Very low significance*: direct/indirect disturbance to Amber listed passerines

10(ii) 5.4 Cumulative Effects

10.(ii).384 Cumulative impacts on bird species are considered likely to be limited to the influence of other wind farms, together with the Graffy Wind Farm proposal, on displacement, collision or barrier impacts on birds. The following existing or consented wind farm are located within 20 km of the proposed development:

• Anarget	6 turbine	6.0 km to south	
• Cluster			
• Clohearvaddy	3 turbines	13.5 km to southwest	Cluster
• Kiln Hill	2 turbine	15.5 km to southwest	
• Corkermore	3 turbines	16.5 km to southwest	
• Garvegort Glebe	4 turbine	15.0 km to WSW (planning expired 28-Jan-2020)	
• Loughderryduff	9 turbines	13.5 km to west	
• Barnesmore	30 turbines	19.0 km to south	Cluster
• Meenadreen	36 turbines	20.5 km to south	
• Meenbog	18 turbines	21.0 km to south (under construction)	
• Meentycat	45 turbines	14.0 km to ENE	Cluster
• Cark	25 turbines	16 km to ENE	
• Culliagh	18 turbines	15.5 km to ENE	
• Meenanilta	12 turbines	19.0 km to east	

10.(ii).385 The closest operational wind farm is 6 km away, which consists of six turbines. Inclusive of wind farms currently under construction it is estimated that there are or will be in the region of 210 turbines in the landscape surrounding the proposed development out to *c*. 20 km. The majority of these are more than 15 km away from the proposed wind farm site at Graffy. Some of the turbines within the current tranche of wind farms are reaching the end of their operation life and re-power projects have been consented (e.g. Barnesmore WF) or may be pursued. Typically, these re-powering projects replace the existing turbines with a smaller number of larger, more efficient turbines.

10.(ii).386 The re-design of the Graffy Wind Farm proposal (embedded mitigation) sees a reduction in the number of previously consented turbines (a reduction from 13 to 8 turbines) and reduces the footprint of the project by a third. The dimension of the turbine array (8 turbines evenly spaced over *c*. 3 km) does not form an excessively elongated or dense barrier effect to avian populations. A very diffuse level of bird passage migration was detected through the area, mostly occurring beyond the 500 m turbine buffer and the proposed wind farm was not found to be on a significant migration route or regularly utilised flight line between roost/breeding site and foraging area. Therefore, it is considered that proposed wind farm sites will not act in combination with other existing or consented wind farms to form a barrier to bird movement.

10.(ii).387 Given the current low density of operational and consented wind farms within 15 km of the proposal, there is not considered to be a risk of cumulative effects that have not been adequately covered in this assessment.

10.(ii).388 It is possible that the potential for cumulative impact may change over time, notably with respect to species with large foraging ranges such as white-tailed and golden eagles. Such potential highlights the importance of an appropriate monitoring programme and associated potential mitigation, should a situation arise whereby usage levels by species prone to collision risk increases as a result of ex situ or cumulative factors. A monitoring programme is detailed in **Section 10(ii) 6.1.5**, with links to potential associated mitigation in **Section 10(ii) 6.1.3**. It is considered that such a programme will be sufficient to cover any changes in usage of the site arising from ex situ or cumulative influences on target bird species.

10(ii) 5.5 Summary of potential significant effects without mitigation

10.(ii).389 The impacts on the avi-fauna outlined above associated with the construction, operational and decommissioning phases of the proposal are largely considered to be *not significant*. Assessed ***in the absence of control measures*** the exceptions to this include:

- Inappropriately timed/phased **construction** works have the potential to result in **direct** disturbance to **breeding**:
  - Merlin ***medium significance***
  - Meadow pipits ***low significance***
  - Sparrowhawk ***low significance***
  - Snipe ***low significance***
  - Amber listed passerines ***low significance***
- Inappropriately timed/phased **construction** works have the potential to result in **indirect** disturbance to **breeding**:
  - Merlin ***medium significance***
  - Whinchat ***low significance***
  - Meadow pipits ***low significance***
  - Sparrowhawk ***low significance***
  - Snipe ***low significance***
  - Amber listed passerines ***low significance***
- The **operational** phase has the potential to result in **direct** (collision) impacts on foraging:
  - White-tailed eagle ***low significance***
  - Golden eagle ***high significance reduced to low/med due to avoidance*** (see Fielding *et al*, 2021)[195]
  - Kestrel ***very low significance***
- The **operational** phase has the potential to result in **indirect** disturbance to **breeding**:
  - Merlin ***medium significance***
  - Whinchat ***low significance***
  - Snipe ***very low significance***

10.(ii).390 ***In the absence of mitigation***, the proposed development has the potential to result in significant effects on Qualifying Interests (QIs) of **designated sites**, with the potential to adversely affect the structure and function of two Special Protection Areas (SPAs) including:

- Indirect/direct impacts during construction and operational phase on breeding merlin a QI of the Lough Nillan Bog SPA

195 Fielding, A.H.; Anderson, D.; Benn, S.; Dennis, R.; Geary, M; Weston, E.; & Whitefield, D.P. (2021). Responses of dispersing GPS-tagged Golden Eagles (*Aquila chrysaetos*) to multiple wind farms across Scotland. *IBIS*

- Indirect (downstream pollution) during construction and operational phase on waterbird QIs of the Lough Foyle SPA (Note: Likelihood of any significance effects considered highly unlikely due separation distance of 77 km between source and receptor)

11.1.3 The following sections highlight embedded mitigation and proposes mitigation/compensatory measures designed to limit the effects of any impacts identified as *Very low*, *Low* or *Medium significance*.

10(II) 6 RECOMMENDATIONS AND MITIGATION

10(ii) 6.1 Proposed mitigation

10.(ii).391 Potential impacts on bird populations have been identified above relating to the construction, operational and decommissioning stages of the proposed wind farm. This section details mitigation required to offset these impacts. Mitigation approaches include mitigation by avoidance and mitigation by reduction and offsetting. Reference to embedded mitigations is also made and involves reducing the numbers of turbines and re-positioning of turbines and associated infrastructure which avoids potentially sensitive avian receptors, including:

- The current proposal has undergone significant amendments since the original proposal was consented, notably the reduction of the proposed number of turbines from 13 to 8, essentially reducing the footprint of the development by a third. This is considered to be embedded mitigation.
- During the design phase of the project the option for a ninth turbine was considered for the area south of T8, adjacent to the Stracashel River; and dropping this turbine excludes any risk of direct and in-direct disturbance to sensitive breeding birds, notably a small number of breeding whinchat. This embedded/design stage mitigation is considered as mitigation by avoidance.
- Likewise, mitigation by avoidance was achieved during the design phase when the proposed locations for T1, T2 and T3 were shifted to the east, north and west respectively. This re-positioning of turbines places them > 500 m from merlin nesting locations occupied during the 2019 and 2020 breeding seasons – see **Appendix 7**, i.e. beyond the zone of influence for construction and operational disturbance.
- Embedded mitigation also includes avoidance of wetter areas of habitat, which have potential to support breeding snipe, and therefore, direct impacts on breeding snipe during the construction phase will be avoided.
- New fencing poses a collision risk to low flying species like merlin, red grouse and sparrowhawk and may also have displacement effects on foraging birds. During the design phase of the project, fencing around turbine bases and access roads will not be permitted.

10(ii) 6.1.1 Construction phase mitigation

10.(ii).392 Any construction works proposed during the nesting bird season (March to August inclusive) will be preceded by a nesting bird survey and associated reporting. The report will detail nesting or prospecting birds in the area and will detail buffer zones and measures required in order to avoid potential disturbance or impact and will be submitted to the Planning Authority prior to the commencement of works. Particular attention will be given to priority bird species and any species known to be sensitive to construction related disturbance (including breeding raptors and waders). Special consideration will be given to breeding sparrowhawk, merlin, snipe, ground nesting passerines (meadow pipit, skylark) and whinchat.

10.(ii).393 There will be no clearance of vegetation suitable for nesting birds within the bird nesting season, unless checked for nesting birds by a suitably qualified ornithologist (performing the role of Ecological Clerk of Works (ECoW)) and cleared by them for removal, taking account of both potential for direct nest destruction and disturbance to nesting birds.

10.(ii).394 Wherever feasible, where suitable nesting habitat removal is required to facilitate the works (such as the footprint of the site track, turbines, hardstands and set down areas, excavation of the grid connection route, any vegetation removal or cutting of overhanging vegetation along the turbine delivery route), including dense ground cover and trees/scrub, it will be undertaken prior to the 1st March in the construction year. Vegetation removal required for creation of bat buffers around turbines, especially around T1 will be undertaken outside the bird breeding season (1st March to 31st August). This will avoid direct disturbance to a known sparrowhawk nest, as well as avoiding direct impacts to other breeding species.

10.(ii).395 Works during the bird nesting season will be supervised on a weekly basis by an appropriately qualified ornithologist (who may also perform the ECoW role if appropriately qualified for both). Their role will be to monitor nesting birds within the construction site and advise on buffer zones required in order to avoid impacts on them. In this regard, special consideration will be given to merlin, sparrowhawk at T1 and whinchat occurring around Graffy Bridge.

10.(ii).396 Construction works will be appropriately phased to avoid seasonally sensitive ornithological receptors, and while this will necessitate a dynamic approach in anticipation of birds potentially moving to different nesting locations within/adjacent to the construction site (as may be the case with merlin), there will be some restrictions in place based on the distribution of birds recorded during the baseline, including:

- Commencement of construction works will not be permitted in the northern sections during the breeding season (1st March to 31st August). Construction works must be phased to ensure that the majority of the northern section of the development (T1 to T4) is completed prior to the onset of the breeding season (1st March).
- Road maintenance works, including excavation and laying of cabling along the grid connection route will not be permitted during the bird breeding season (1st March to 31st August) for two sections, including:
  - along the L-6743 secondary local road between junctions to T1 and T4
  - from the met mast and following the L-2593 along the Stracashel River for 500 m after the Graffy Bridge turn
- No construction will be permitted within 500 m of the merlin nesting location identified during the baseline surveys during the breeding season. Construction works are defined as all heavy civil works (including turbine erection) and all preparatory/finishing works (including vegetation clearance, road capping, landscaping, fencing and light, manual tasks). Specifically, this will limit all works on tracks leading to T1/T2 and T4/T3 within 500 m of the baseline nest

sites. While no heavy civil works will be permitted during the breeding season, construction traffic will be facilitated access to work areas beyond the 500 m buffer via the junction to T4/T3 and junction to T1/T2.

- If merlin occupy an alternative nest site during construction, a 500 m exclusion zone buffer will be applied where all construction activities will only be permitted outside the bird breeding season (1st March to 31st August). Depending on the location of the nest, additional access restrictions may also be applied.

10.(ii).397 An Ecological Clerk of Works (ECoW) will be employed for the duration of the construction period. Their role will include oversight of construction works with respect to compliance with all ecological mitigation and ecological legislative compliance. The full role of the ECoW is described within the Outline Construction Environmental Management Plan (OCEMP). With respect to birds, their role will include:

- Providing advice to ensure legal compliance with respect to nesting birds;
- Ensuring that all required exclusion zones for nesting birds are adequately set out, protected and signed-off, and that all contractors working on the site abide by them;
- Ensuring suitable measures are in place to protect retained or created habitats;
- Undertaking the necessary pre-construction protected species surveys (if suitably qualified) and supervising the implementation of any mitigation measures required;
- Liaison with contractors and construction staff working on site;
- Providing regular on-site advice with respect to any ecological issues that arise.

10.(ii).398 Compensatory measures are required to offset the potential displacement of 1-2 pairs of snipe breeding within 400 m of construction works (as well as operational turbines). Within the landholdings under the Applicant's 'control', areas beyond the 400 m turbine buffer have been identified for the creation or enhancement of existing wet areas for breeding snipe. This includes a variety of habitats, including semi-improved grassland as well as wet heath, upland blanket bog, marshy grassland and areas with wet flushes. The core target area will be along the Stracashel River and will tie in with enhancement measures for breeding whinchat. The feasibility of blocking some of the bog hags on the top of Graffy Hill and creating more stabilised wet areas of blanket bog will be investigated.

10.(ii).399 Measures specifically designed to ensure threats to water quality are mitigated against during construction for the protection of freshwater pearl mussels and salmonids, will more than adequately ensure any downstream avian receptors are protected from any pollution or sedimentation effects.

10(ii) 6.1.2 Enhancement measures

10.(ii).400 Several enhancement measures are proposed and these should be implemented/agreed with detailed plans provided prior to the commencement of constructions works, including:

- Provision of nesting baskets for merlin. Suitable locations in the area surrounding the wind farm will be targeted for the erection of nest baskets to provide a greater range of nesting options for merlin than is currently available. It is suggested that five general locations are selected and up to 15 baskets are erected. Locations up to 5 km from the wind farm site will be considered, if agreements with landowners can be secured. Ongoing monitoring will be undertaken post-construction to investigate levels of uptake.
- Securing agreements with landowners to implement habitat management measures designed to protect and enhance (if appropriate) the fields of wet grassland along the Stracashel River for breeding whinchat. Implementation will be monitored as part of the post-construction ornithological monitor program and the aim will be to increase the breeding density of whinchat in the area.
- Securing agreements with landowners to implement habitat management measures designed to create or enhance existing wet areas beyond the 400 m turbine buffer for breeding snipe. As well as providing enhancement, this is considered as compensatory mitigation to offset the potential displacement of 1-2 pairs of breeding snipe during the construction and operational phase of the project.
- In the wider area, kestrels may be struggling with inter-specific nest site competition; as aggressive interaction with raven was noted during the 2020 breeding season. Provision of four nest boxes at selected sites along the Stracashel River valley is recommended to provide this species more nesting options in the area. Potential sites have been identified with locations beyond the1 km turbine buffer being targeted and pending securing landowner agreements.
- Where stream crossings are proposed these should be designed to including nesting crevices for grey wagtail. Provision of nest boxes/holes for dippers could also be considered.

11.1.4 Measures to compensate for potential loss of foraging habitat for golden eagle or white-tailed eagle are not considered a requirement, as the proposed wind farm site is considered largely sub-optimal for golden eagle and only of interest to white-tailed eagles due the availability of carrion. However, as an enhancement measure, it is recommended that the wind farm company provide funding support to a red grouse conservation project in Co. Donegal or neighbouring county with potential to support breeding eagles. Funding would be targeted at undertaking habitat enhancement measures for red grouse. An alternative location for provision of carrion could also be investigated.

10(ii) 6.1.3 Operational phase mitigation

10.(ii).401 One of the main concerns during the operational phase of the project is potential mortality of white-tailed eagles and golden eagles due to collisions with turbines. Potential collision risk for merlin was addressed through embedded (design phase) mitigation, involving the re-locating of three turbines away from nest sites used during the baseline and by prohibiting erection of new fencing erected around wind farm infrastructure. In relation to limiting collision risk for the aforementioned species, the reduction from the originally consented 13 turbine wind farm in 2011 to the 8 turbines proposed in 2021 is considered as embedded mitigation in this regard.

10.(ii).402 Further mitigation by avoidance, was achieved by avoiding turbine placement in areas identified as attracting the most eagle flight activity. Despite more profitable wind generating options further up the slopes of Aghla Mountain, the position of the turbine array has been kept below the steeper gradients and exposed rock on the southern slopes of the mountain. This avoids the upper sections of the mountain that generate the thermals and up drafts, which attract soaring birds like eagles. Hötker *et al.* (2006)[196] reviewing collision risk found that wind farms near wetlands and mountain ridges had significantly more collision fatalities than in other more common landscapes. In addition, at Graffy potential prey species for golden eagles in the form of red grouse and hare were considered to occur at high densities on the slopes above the 500 m turbine buffer. Within the wind farm site carrion was considered to be the core food source for eagles.

10.(ii).403 Baseline surveys have highlighted that there is limited suitable eagle nesting habitat within 2km of the proposed wind farm, and the main mitigation methods proposed to reduce potential collision/mortality largely relate to measures intended to reduce the attractiveness of the site for foraging eagles. These measures include:

- Application of a strict farm hygiene protocol, notably ensuring rapid removal of fallen animals
- Controls on lambing and calving in proximity to turbine locations – extending out to the *c.* 1 km turbine buffer along the north-western boundary of the wind farm site and to the local road (L-6743) passing through the 500 m turbine buffer.
- The clearance of any fallen non-domestic animals, like deer and foxes will also be undertaken. This should also include the removal of smaller items, like birds and rabbits/hares.
- Areas in the forest plantation within the 500m turbine buffer must be checked and carrion removed.

10.(ii).404 The current grazing regime (in terms of livestock units) will be retained across the upland portion of the 500 m turbine buffer. This measure will ensure that the areas around the turbines retain the short, unstructured vegetation cover that provides limited suitability for prey species of golden eagle (notably red grouse and hare).

10.(ii).405 A post-construction monitoring programme will be implemented to investigate post-construction eagle activity within and adjacent to the wind farm site – see **Section 10(ii) 6.1.5**. As both the

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196 Hötker, H., Thomsen, K.M. & Jeromin, H. (2006). Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats - facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation. Michael-Otto-Institut im NABU, Bergenhusen.

white-tailed eagle and golden eagle populations are in a pioneering phase there is a level of uncertainty concerning future use of the area, especially for white-tailed eagles. Therefore, taking a precautionary approach towards mitigation; it is recommended that based on observations during post-construction monitoring there is a contingency to adopt further mitigation measures, if for instance, white-tailed eagle activity in the area is seen to increase significantly, possibly due to a pair becoming established in the environs of the site. There are several measures/technologies emerging as highly effective tools for limiting collision risk in eagles, including:

- Painting a single blade black has been shown to limit turbine fatalities by over 70% at Smøla wind-power plant in Norway – see May *et al.* (2020)[197].
- Automated systems, such as IdentiFlight, which is a bird detection system being tested for golden eagle interactions at wind farm sites in the USA. This system is capable of identifying eagles beyond the 500 m turbine envelope and instructs turbines to instigate curtailment measure as required – see McClure *et al.* (2018[198] & 2021[199]). The system is very sophisticated, employing artificial intelligence technology that is able to identify birds within 5 seconds, calculate flight velocity and being linked to the turbines is able to order an automated shutdown within 30 seconds. This allows eagles and other birds to pass through the wind farm safely and has been shown to reduce fatality rates by 75-89%.

11.1.5 Measures specifically designed to ensure threats to water quality are mitigated against during operations for the protection of freshwater pearl mussels and salmonids, will more than adequately ensure any downstream avian receptors are protected from any pollution or sedimentation effects.

10(ii) 6.1.4 Decommissioning phase mitigation

Decommissioning phase impacts are likely to be broadly similar to construction phase impacts, in terms of disturbance through increased noise levels, ground clearance works, and reinstatement. The implementation of all mitigation measures detailed in the construction phase will help ensure that all such impacts are avoided.

Therefore, it is proposed that a Decommissioning Plan be drafted prior to removal of the development infrastructure. This will be put into place containing specific actions aimed at protecting important species, including all the mitigation measures specified for the construction phase. These include limitations on the working corridor, minimised impact on vegetation, and protection of nesting birds. A pre-decommissioning bird survey should be undertaken with the specific objective of identifying any species of nature conservation

197 May, R., Nygård, T., Falkdalen, U., Åström, J. Hamre, Ø. & Stokke, B. G. (2020). Paint it black: Efficacy of increased wind turbine rotor blade visibility to reduce avian fatalities. *Ecology and Evolution* 00:1-9

198 McClure, C.J.W., Martinson, L. & Allison, T.D. (2018). Automated monitoring for birds in flight: Proof of concept with eagles at a wind power facility. *Biological Conservation* 224: 26-33

199 McClure, C.J.W., Rolek, B.W., Dunn, L., McCabe, J.D., Martinson, L. & Todd, K. (2021). Eagle fatalities are reduced by automated curtailment of wind turbines. *J Appl Ecol*. 58: 446-452

importance that may be affected by the decommissioning phase and works timed accordingly to avoid sensitive periods.

10(ii) 6.1.5 Monitoring

10.(ii).406 Ornithological monitoring surveys will be carried out in the year prior to management actions being implemented/construction year and in post-construction years 1, 2, 3, 4, 5, 10 and 15. Pre-decommissioning ornithological surveys will also be required. Surveys will include:

- Vantage point surveys to SNH guidelines from 4 vantage points during both breeding and non-breeding seasons.
- Wider area breeding eagle/ merlin surveys, initially to a distance of 6 km from the site for eagles (pre-construction surveys and in post-construction years 1, 2, 3, 4, 5, 10 and 15).
- Breeding season walkovers – upland breeding bird surveys (pre-construction surveys and in post-construction years 1, 2, 3, 4, 5, 10 and 15).
- Fatality monitoring within the wind farm during post-construction years 1, 2, 3, 4, 5, 10 and 15.

10(ii) 6.2 Summary of effects

10.(ii).407 The ornithological impacts (detailed in **Section 10(ii) 5.3,** which covers the assessment of potential effects associated with the construction, operational and decommissioning phases of the proposal) are largely considered to be either *not significant*, or of *low* to *very low significance*. The exception to this is the potential impacts on merlin during the construction and operational phases of the proposed development. It is considered that the proposal has the potential to result in an impact of *medium significance* on this species in the absence of mitigation.

10.(ii).408 Following the application of the proposed mitigation measures (as outlined in **Section 10(ii) 6.1**; and including avoidance through embedded mitigation and restrictions on the timings and phasing of construction works) the proposal has the potential to result in a residual impact that is considered *not significant* for breeding merlin.

10.(ii).409 Likewise, proposed mitigation measures designed to control for construction phase impacts of *low significance* on breeding sparrowhawk, snipe and passerine species (including whinchat, meadow pipit and skylark) will result in residual impacts that are considered *not significant* for all avian species potentially breeding within the zone of influence of the proposed wind farm.

10.(ii).410 Habitat creation, management and enhancement are proposed as mitigation/compensation for operational impacts relating to potential displacement effects of *low significance* for breeding whinchat and *very low significance* for snipe, which will result in residual impacts that are considered *not significant* for both species.

10.(ii).411 A hygiene protocol for the wind farm site is proposed as mitigation for operational impacts relating to potential collision risk of *low significance* for foraging white-tailed eagles and golden eagles, which will result in residual impacts that are considered *not significant* for golden eagle. However, as there is some uncertainty regarding future use of the area by white-tailed eagle, additional post-construction mitigation may be required. This will be informed by ongoing monitoring and may involve requirements to paint one blade black or employing an automated curtailment system. Therefore, a residual impact of *very low significance* remains for foraging white-tailed eagles.

10.(ii).412 No mitigation is forwarded to limit collision risk for foraging kestrel and a residual impact of *very low to low significance* remains for this species. To offset predicted mortality of 2.21 birds over the life span of the project, nest boxes will be erected in the wider area to limit inter-specific nest site competition and increase productivity for this species.

10.(ii).413 Potential effects and residual impacts are summarised in **Table 9** for construction phase impacts and **Table 10** for operational phase impacts.

10(ii) 6.3 Statement of significance

10.(ii).414 The site of the proposed wind farm holds a bird assemblage in keeping with what would be expected in the context of a marginalised upland site in Co. Donegal, encompassing a mosaic of semi-improved agricultural grassland, unimproved acid grassland, bog, heath and conifer plantation. Some 71 species were recorded within the site during surveys, many of which are reliant on the upland (peat derived) habitats within the site, with the introduction of commercial forestry plantations facilitating the occurrence of more woodland/scrub species.

10.(ii).415 Notable species include:

- Merlin which is Amber listed on BoCCI and listed under Annex I of the EU Birds Directive were breeding adjacent to the proposed wind farm site.
- Golden eagle and white-tailed eagle, both Red listed on BoCCI and listed under Annex I of the EU Birds Directive were found utilising the southern slopes of Aghla Mountain. Golden eagles have established breed sites that are beyond the 6 km turbine buffer. No white-tailed eagle breeding sites were identified within the 6 km turbine buffer.
- The Stracashel River valley adjacent to Graffy Bridge support 1-2 pairs of whinchat, a rare breeding species in Ireland that is Red listed.
- The lower slopes of Aghla Mountain bordering the wind farm site support 3-4 grouse territories and this species is Red listed on BoCCI.
- There are also two to three snipe holding breeding territories within or adjacent to the wind farm site and this species is Amber listed on BoCCI (2014-19), upgraded to Red list (BoCCI 2020-2026).

- Other amber listed breeding raptors utilising the wind farm site include sparrowhawk (now Green listed BoCCI 2020-26) nesting in conifer plantation near T1 and kestrel nesting within *c*. 1 km of T5 (now Red listed BoCCI 2020-26).

10.(ii).416 Analysis of the potential effects of collision risk and disturbance/displacement, with consideration given to proposed mitigation measures resulted in residual impacts that are considered of *very low significance* for white-tailed eagle and *low significance* to *very low significance* for kestrel. For all other avian species residual impacts are considered *not significant*.

Table 9. Summary of **construction phase** impacts assessment on key ornithological receptors

Receptor	Nature Conservation Importance	Potential Impact Direct/ Secondary	Magnitude / Duration	Significance	Level of Certainty / Comments	Mitigation	Residual Impact
CONSTRUCTION PHASE (AND DECOMMISSIONING PHASE)							
Merlin	Very high	Direct: nest site Secondary: disturbance – breeding site, possible displacement	Low Temporary - Short-term	Medium significance	For baseline - pair nesting adjacent to sections of proposed construction corridor in the T1-T4 area (200-730m). There are trees within corridor with potential suitability for nesting merlin; however, usage uncertain as nest locations dependent on occurrence of corvid nests. Surveying will be required to identify nest locations in any given breeding season, as merlin often alternate between different sites and sometimes over a wide area. Sensitivity to secondary disturbance of breeding pairs likely to be largely dependent on behavioural traits of individual birds and some degree of tolerance in anticipated. Negligible impact for foraging birds	All vegetation removal within the works corridor to be undertaken prior to the onset of the bird breeding season. The works corridor will be inspected prior to construction works commencing to ensure that there are is no residual nesting options remaining. Construction phase ornithological monitoring to identify nest site and ensure the implementation of appropriate exclusion zone buffers around nest During the breeding season phased construction works to ensure no heavy civils works conducted within 500m of known nests/any alternative sites., including no excavation Pre-construction provision of alternative nesting options (nest baskets) in the wider area	Negligible magnitude – not significant
White-tailed eagle	High	Direct: none Secondary: limited foraging	Negligible Temporary - Short-term	Not significant	Relatively low usage of the site observed, no nest sites identified within 6km, all potential nesting opportunities beyond zone of influence for direct & secondary disturbance	None required Removal of fallen livestock and other sources of carrion will be removed during construction	None
Hen harrier	High	Direct: none Secondary: limited foraging	Negligible Temporary - Short-term	Not significant	No breeding within 2km and disturbance is not considered to be significant due to the low level of activity within the environs of the wind farm site	None required	None
Golden eagle	High	Direct: none Secondary: limited foraging	Negligible Temporary - Short-term	Not significant	Relatively low usage of the site observed, no nest sites identified within 6km, all potential nesting opportunities beyond zone of influence for direct & secondary disturbance	None required – removal of fallen livestock and other sources of carrion will be removed during construction	None
Whooper swans	Medium	Direct: none Secondary: limited passage	Negligible Temporary - Short-term	Not significant	Low usage observed, limited to small numbers on passage. All roosting sites or foraging areas identified were beyond zone of influence for direct & secondary disturbance	None required	None

Receptor	Nature Conservation Importance	Potential Impact Direct/ Secondary	Magnitude / Duration	Significance	Level of Certainty / Comments	Mitigation	Residual Impact
CONSTRUCTION PHASE (AND DECOMMISSIONING PHASE)							
Red grouse	Medium	Direct: none Secondary: foraging	Negligible Temporary - Short-term	Not significant	No suitable nesting habitat within the work corridor. Temporary short-term displacement of foraging birds away from works corridor anticipated	None required	None
Peregrine	Medium	Direct: none Secondary: Disturbance	Negligible Temporary - Short-term	Not significant	Disturbance is not considered to be significant due to the low level of activity within the Application Site and no breeding within c. 2 km of Application Site	None required	None
Golden plover	Medium	Direct: none Secondary: none	Negligible Temporary - Short-term	Not significant	Disturbance is not considered to be significant due to the low level of activity within the Application Site.	None required	None
Red listed breeding passerines	Whinchat WC Medium-High Meadow pipit MP Medium Grey wagtail GL Medium	Direct: nest site (MP) Secondary: disturbance of breeding birds (WC, GL)	Whinchat High Meadow pipit Low Grey wagtail Negligible Temporary - Short-term	Whinchat: Very high significance Meadow pipit: Low significance Grey wagtail: Not significant	Whinchat – two pairs breeding along Stracahshel River – beyond works corridor, potential for secondary disturbance Meadow pipit – multiple pairs nesting within and adjacent to works corridor Grey wagtail – nesting habitat avoided by works corridor	Embedded mitigation – a ninth turbine proposed for an area adjacent to whinchat breeding areas along the Stracahel River was dropped from the final design. Construction phase ornithological monitoring to identify nest sites and ensure the implementation of appropriate exclusion zone buffers around nest sites Pre-breeding season removal of nesting cover within works corridor Enhancement measures: Create nesting holes for grey wagtails at stream crossings Manage wet grassland along the Stracashel River valley for whinchat	Reducing magnitude of effect to: • Low for whinchat (close monitoring required) • Negligible for meadow pipit • Not significant for grey wagtail
Sparrowhawk	Low – now downgraded to Not sensitive based on BoCCI4 (Gilbert *et al.*, 2021) green listing	Direct: nest near T1 Secondary: disturbance of breeding birds, possible displacement	Negligible Temporary - Short-term	*National population*: Not significant *Local population*: Very low significance	The baseline identified a breeding territory within/adjacent to the felling buffer for T1. In appropriate timing for the removal of vegetation (i.e. during the breeding season) will directly impact on the nest if the pair nests within the felling buffer or has the potential to result in disturbance to breeding birds if nesting in forestry adjacent to the felling buffer. Species is considered tolerant to loss of woodland habitat in the context of commercial forestry plantations.	All vegetation removal within the works corridor to be undertaken prior to the onset of the bird breeding season. The works corridor will be inspected prior to construction works commencing to ensure that there are is no residual nesting options remaining. Construction phase ornithological monitoring to identify nest site and ensure the implementation of appropriate exclusion zone buffers around nest any nests identified	Negligible magnitude – not significant

Receptor	Nature Conservation Importance	Potential Impact Direct/ Secondary	Magnitude / Duration	Significance	Level of Certainty / Comments	Mitigation	Residual Impact
CONSTRUCTION PHASE (AND DECOMMISSIONING PHASE)							
Kestrel	Low – now upgraded to <u>Medium</u> based on BoCCI4 (Gilbert *et al.*, 2021) red listing	Direct: none Secondary: displacement of foraging birds	Negligible Temporary - Short-term	Not significant	The baseline did not locate any nest sites within the works corridor and the closest nest site was beyond the beyond zone of influence; therefore, the risk of direct/indirect disturbance to breeding birds was considered not significant, unless nesting birds relocated to a nest within/adjacent to the works corridor. Nesting opportunities within/adjacent to the works corridor were limited and kestrels would be reliant on corvid nests in trees and nest competition with merlin likely to be limit option further. The area around T4 was identified. The potential effect of displacement on foraging birds was it was considered to be negligible.	All vegetation removal within the works corridor to be undertaken prior to the onset of the bird breeding season. The works corridor will be inspected prior to construction works commencing to ensure that there are is no residual nesting options remaining. Construction phase ornithological monitoring to identify nest site and ensure the implementation of appropriate exclusion zone buffers around any nests identified. Provision of four nest boxes in the wider area at location beyond the 1km turbine buffer	None
Snipe	Low – now upgraded to <u>Medium</u> based on BoCCI4 (Gilbert *et al.*, 2021) red listing	Direct: none Secondary: disturbance of breeding birds, possible displacement	Low Temporary - Short-term	Very low significance upgraded to Low significance	Two-three breeding territories identified within 500m turbine buffer, with a low-density wintering population. The works corridor avoids potential breeding sites (wet areas), therefore direct impact to breeding sites considered unlikely. There is potential for the displacement of 1-2 pairs of snipe during construction, as well as displacement of small number of birds using the site over the winter.	Avoidance of potential nesting habitat – wet areas Compensatory habitat measures to offset potential displacement of 1-2 pairs breeding snipe. Construction phase ornithological monitoring to identify nest site and ensure the implementation of appropriate exclusion zone buffers around any nests identified.	Not significant
Jack snipe	Low – now downgraded to Not sensitive based on BoCCI4 (Gilbert *et al.*, 2021) green listing	Direct: none Secondary: disturbance/ displacement wintering breeding	Negligible Temporary - Short-term	Not significant	Small numbers recorded on passage/ wintering within 500m turbine buffer. Potential for displacement of foraging birds	None required Note - Compensatory habitat measures for common snipe are likely to have a positive effect on habitat availability for wintering/ passage Jack snipe.	None

Receptor	Nature Conservation Importance	Potential Impact Direct/ Secondary	Magnitude / Duration	Significance	Level of Certainty / Comments	Mitigation	Residual Impact
CONSTRUCTION PHASE (AND DECOMMISSIONING PHASE)							
Breeding Amber listed passerines – goldcrest, skylark, spotted flycatcher, starling, swallow & wheatear, with willow warbler added based on BoCCI 2020-26 With downgrades to Green list for mistle thrush↓, robin↓ & stonechat↓	Low	Direct: nest site Secondary: disturbance	Low Temporary - Short-term	Low significance	All recorded breeding within the 500m turbine buffer. Availability of nesting habitat for some species including swallows, spotted flycatchers, starlings does not occur within the works corridor and therefore direct disturbance to these species considered unlikely.	All vegetation removal within the works corridor to be undertaken prior to the onset of the bird breeding season. The works corridor will be inspected prior to construction works commencing to ensure that there are is no residual nesting options remaining. Construction phase ornithological monitoring to identify nest sites and ensure the implementation of appropriate exclusion zone buffers around any nests identified.	Not significant

Table 10. Summary of **operational phase** impacts assessment on key ornithological receptors

Receptor	Nature Conservation Importance	Potential Impact Direct/ Secondary	Magnitude / Duration	Significance	Level of Certainty / Comments	Mitigation	Residual Impact
OPERATIONAL PHASE							
Merlin	Very high	Direct: collision with turbines & fences Secondary: disturbance	Negligible, if lowest extent of rotor swept area >20m Low Temporary - Long-term (25 years)	Not significant for turbines Medium for fences Medium	Predicted collision risk with turbines was found to be low; and even before re-locating turbines was the risk was estimated at 0.73 collisions over 30 years. New fencing considered as presenting a higher collision risk than turbines and may also have a displacement effect.	Embedded mitigation – re-locating T1 & T2 ensuring all turbines are located more than 500m know nest sites. Lowest rotor swept extent will be >20m Pre-construction provision of alternative nesting options (nest baskets) in the wider area. No new fencing with permitted around turbines and associated infrastructure	Not significant

White tailed eagle	High	Direct: collision with turbines Secondary: none	Low Temporary - Long-term (30 years)	Low significance for predicted collision risk	No breeding sites were located within the 6 km turbine buffer. High levels of display behaviour were observed in the wider area, which was considered to be birds pairing up, prospecting sites and testing the boundaries of potential breeding season home ranges. Over the 2-year study white-tailed eagle flight activity through the 500 m turbine buffer was recorded on seven dates (eight observations) and involved at least two adults (1 tagged/1 untagged) and an immature/ sub-adult bird. Based on a conservative predicted collision risk (employing 95% avoidance rate) for the proposed wind farm site (0.26 birds per annum) and for a population of 36 birds (with c. 30% sub-adult birds) the additional mortality is < 5%, which is assessed as having a *Low* magnitude of effect White-tailed eagles show weak behavioural responses to wind farm avoidance, especially sub-adult birds Therefore, the effect of displacement due to the footprint of the operational wind farm is considered to be *negligible*	Embedded mitigation - reduction from the originally consented 13 turbine wind farm to the 8 turbines. Further mitigation by avoidance, was achieved by avoiding turbine placement in areas identified as attracting the most eagle flight activity, i.e. locating turbines away from upper sections of the mountain that generate the thermals and up drafts that attract soaring birds. Measures intended to reduce the attractiveness of the site for foraging eagles are proposed including: • Application of a strict farm hygiene protocol, notably ensuring rapid removal of fallen animals • Controls on lambing and calving in proximity to turbine locations. • The clearance of any fallen non-domestic animals, including the removal of smaller items. • Areas in the forest plantation within the 500m turbine buffer must be checked. • The current grazing regime to be retained across the upland portion of the 500 m turbine buffer. This retains the short, unstructured vegetation providing limited cover for prey species. A post-construction monitoring programme will be implemented to investigate post-construction eagle activity within and adjacent to the wind farm site. It is acknowledged that there is a level of uncertainty concerning future use of the area. Therefore, taking a precautionary approach towards mitigation; it is proposed that based on observations during post-construction monitoring there is a contingency to adopt further mitigation measures, if for instance, eagle activity in the area is seen to increase significantly, possibly due to a pair becoming established in the environs of the site. There are several measures/technologies emerging as highly effective tools for limiting collision risk in eagles, including automated systems, such as IdentiFlight, which has been shown to reduce fatality rates by 75-89%.	Very low significance

Receptor	Nature Conservation Importance	Potential Impact Direct/ Secondary	Magnitude / Duration	Significance	Level of Certainty / Comments	Mitigation	Residual Impact
OPERATIONAL PHASE							
Hen harrier	High	Direct: collision with turbines Secondary: displacement of foraging birds	Negligible Temporary - Long-term (30 years)	Not significant	No breeding recorded within 2km and birds were only recorded on four dates over the two years. Based on low recorded usage of the wind farm and very low predicted collision risk, the magnitude of effect due to direct operational impacts are considered *negligible*. Operational turbines may have a localised effect, displacing the occasional individual foraging around turbines. However, in consideration of the availability of alternative foraging areas within the wider area and because the intermittent level of recorded usage of the area clearly demonstrates that hen harriers are not exclusively reliant on the proposed wind farm site, potential secondary impacts on foraging harriers are assessed as *negligible*	None required	None

Receptor	Nature Conservation Importance	Potential Impact Direct/ Secondary	Magnitude / Duration	Significance	Level of Certainty / Comments	Mitigation	Residual Impact
OPERATIONAL PHASE							
Golden eagle	High	Direct: collision with turbines Secondary: displacement of foraging birds	Low Negligible Temporary - Long-term (30 years)	High significance for predicted collision risk; however, reduced to low significance based on evidence from satellite tracking study (Field *et al.* 2021) Not significant for potential displacement effects	No breeding territories were identified within 6km of the Application Site. Over the 2-year study golden eagle flight activity through the 500 m turbine buffer was recorded on 16 dates (19 observations) and involved several different birds including adults and sub-adults. Based on observed flight activity within the 500 m turbine buffer, the collision risk (weighted and applying avoidance rate) was predicted to be 1.73 collisions over 30 years, equivalent to 1 bird every 17 years, which has the potential to contribute an additional 6% to annual background mortality. The magnitude of this effect was assessed as a *Low* to *Moderate* population effect, resulting in an impact of *Low* to *High significance*. However, research suggests displacement of golden eagles due to wind farm infrastructure, rather than collision risk, may present a more significant impact resulting from wind farm developments in upland areas. The quality of foraging habitat within the wind farm site was considered relatively poor for golden eagle, with limited cover for prey species and the occurrence conifer plantation throughout. Based on relatively low observed usage of the wind farm site by foraging golden eagles and occurrence of sub-optimal forging habitats (plantations) it is considered that the effect of potential displacement due operational turbines will have a *negligible* effect on the regional population and therefore is *not significant*.	As for white-tailed eagle	Not significant

Receptor	Nature Conservation Importance	Potential Impact Direct/ Secondary	Magnitude / Duration	Significance	Level of Certainty / Comments	Mitigation	Residual Impact
OPERATIONAL PHASE							
Whooper swan	Medium	Direct: collision with turbines Secondary: none	Negligible Temporary - Long-term (30 years)	Not significant	The footprint of the operational wind farm will not result in the direct loss of foraging or roosting habitat used by whooper swans. All recorded usage in the wider area by foraging or roosting birds was > 2 km from the proposed wind farm site. Based on observed usage of the wind farm site it can be excepted that once the wind farm becomes operational there may be the occasional disruption to whooper swans flying through the area on passage, including the risk of colliding with the turbines. Based on infrequent flights of small numbers the predicted collision risk was low and was considered to be below background rates and would have an imperceptible impact on whooper swan populations wintering in Ireland	None required	None
Red grouse	Medium	Direct: collision with turbines Secondary: disturbance	Negligible Temporary - Long-term (30 years)	Not significant	Red grouse populations may suffer some displacement during construction (Pearce-Higgins *et al.*, 2012); however, post-construction numbers tend to recover and operational wind farms are generally considered to have a neutral impact on red grouse (Pearce-Higgins *et al.*, 2009; Douglas *et al.*, 2011). While not totally immune to collisions with turbines, especially where the rotor swept zone extends below 20 m, red grouse with their predominately ground based existence, high fecundity and short, low flights exhibit low vulnerability to collision.	None required	None

Receptor	Nature Conservation Importance	Potential Impact Direct/ Secondary	Magnitude / Duration	Significance	Level of Certainty / Comments	Mitigation	Residual Impact
OPERATIONAL PHASE							
Peregrine	Medium	Direct: collision with turbines Secondary: disturbance	Negligible Temporary - Long-term (30 years)	Not significant	Predicted collision risk is not considered to be significant due to the low level of activity within the 500m turbine buffer and no breeding within 2 km of Application Site. Over the two-year study only two peregrine flight lines were recorded within the 500 m turbine buffer during VP watches and both flight lines were below the collision risk zone.	None required	None
Golden plover	Medium	Direct: collision with turbines Secondary: disturbance	Negligible Temporary - Long-term (30 years)	Not significant	Over the two study years golden plover were only observed on passage three times. All records were of birds detected beyond the 500 m turbine buffer.	None required	None
Red listed breeding passerines	<u>Whinchat</u> WC Medium-High <u>Meadow pipit</u> MP Medium <u>Grey wagtail</u> GL Medium	Direct: nest site (MP) Secondary: disturbance of breeding birds (WC, GL)	<u>Whinchat</u> Low to moderate <u>Meadow pipit</u> Low <u>Grey wagtail</u> Negligible Temporary - Long-term (30 years)	<u>Whinchat</u>: Low significance <u>Meadow pipit</u>: Not significant <u>Grey wagtail</u>: Not significant	Whinchat are a notably rare breeding species in Ireland and two pairs were recorded breeding in the vicinity of Graffy Bridge. There is potential for an inappropriately designed wind farm to result in loss of habitat for this species and for operational disturbance to result in displacement of this regionally important breeding site. It is anticipated that there will be no disturbance or displacement of breeding meadow pipits or grey wagtails due to operational activities. Pearce-Higgins *et al.* (2012) suggest positive effects for breeding densities for meadow pipits on wind farm site post-construction related to changes in vegetation structure improving nesting opportunities. Meadow pipit were a common and widespread species throughout areas of open bog and unimproved of acid grassland within the wind farm site. A single pair of grey wagtail were thought to be breeding within the 500m turbine buffer	Embedded mitigation – a ninth turbine proposed for an area adjacent to whinchat breeding areas along the Stracahel River was dropped from the final design. Implement habitat management measures designed to protect and enhance (if appropriate) the fields of wet grassland along the Stracashel River for breeding whinchat. Implementation will be monitored as part of the post-construction ornithological monitor program and the aim will be to increase the breeding density of whinchat in the area.	If habitat management for whinchat is implemented then there is potential for positive effect in securing habitat availability for the local breeding population

Receptor	Nature Conservation Importance	Potential Impact Direct/ Secondary	Magnitude / Duration	Significance	Level of Certainty / Comments	Mitigation	Residual Impact
OPERATIONAL PHASE							
Sparrowhawk	Low – now downgraded to Not sensitive based on BoCCI4 (Gilbert *et al*., 2021) green listing	Direct: collision with turbines Secondary: none	Negligible Temporary - Long-term (30 years)	Not significant	Wind farm construction and operation is likely to result in the displacement of a sparrowhawk territory in the vicinity of T1. Bird regularly use the site; but the majority of flights are considered to be low level (< 20 m) and this inherently reduced the likelihood of collision for this species. It is likely the displaced pair will relocate to a nest site the general area. Higher altitude display/territorial flights are observed during the breeding season and there may be a seasonal increase in collision risk for this species. Predicted effects turbine mediated mortality are considered negligible at the population level. In terms of secondary impacts, foraging and possibly breeding sparrowhawk do not appear to be suffer displacement effects from operational turbines.	None required	None
Kestrel	Low – now upgraded to <u>Medium</u> based on BoCCI4 (Gilbert *et al*., 2021) red listing	Direct: collision with turbines Secondary: none	Negligible Temporary - Long-term (30 years)	*National population*: Not significant *Local population*: Very low significance, upgraded to Low significance (based on recent Red listing)	Flight behaviour makes this species susceptible to collisions with turbines and this is acknowledged within the collision risk model, which is run with a lowered avoidance rate (95% avoidance rate). Based on observed flight activity within the 500 m turbine buffer, the collision risk (weighted and applying avoidance rate) was predicted to be 5.01 collisions over 30 years. Despite declining numbers, kestrel remain a common and widespread raptor in Ireland and based on the National population the magnitude of effect is considered Negligible. However, effect on the local population due to collisions was considered to be Low. In terms of secondary impacts, foraging and possibly breeding kestrel do not appear to be suffer displacement effects from operational turbines.	None required	None Possible residual impact for local kestrel population of Very Low significance to Low significance

Receptor	Nature Conservation Importance	Potential Impact Direct/ Secondary	Magnitude / Duration	Significance	Level of Certainty / Comments	Mitigation	Residual Impact
OPERATIONAL PHASE							
Snipe	Low – now upgraded to Medium based on BoCCI4 (Gilbert *et al.*, 2021) red listing	Direct: collision with turbines Secondary: displacement	Negligible Low (breeding) Negligible (wintering) Temporary - Long-term (30 years)	Not significant Very low significance upgraded to Low significant	Two-three breeding territories identified within 500m turbine buffer, with a low-density wintering population. Fatalities due to turbine collisions are reported and breeding snipe may be at higher risk of collision, due to the flight behaviour; however, population effect considered negligible. Snipe are considered to be susceptible to displacement from operational wind turbines and breeding densities may reduce by uo to 47.5% within 400m of turbines (Pearce-Higgins *et al.*, 2009)	Compensatory habitat measures to offset potential displacement of 1-2 pairs breeding snipe.	Not significant
Jack snipe	Low – now downgraded to Not sensitive based on BoCCI4 (Gilbert *et al.*, 2021) green listing	Direct: collision with turbines Secondary: displacement	Negligible Temporary - Long-term (30 years)	Not significant	Potential collision risk is not considered to be significant due to the low level of activity within the Application Site	None required Note - Compensatory habitat measures for common snipe are likely to have a positive effect on habitat availability for wintering/ passage Jack snipe.	None
Amber listed breeding passerines goldcrest, skylark, spotted flycatcher, starling, swallow & wheatear, with willow warbler added based on BoCCI 2020-26 With downgrades to Green list for mistle thrush↓, robin↓ & stonechat↓	Low	Direct: collision with turbines Secondary: displacement	Negligible Temporary - Long-term (30 years)	Not significant	Amber listed passerines breeding within the wind farm site are considered relativity abundant and widespread species and have high reproductive rates, with populations that are unlikely to be affected to any degree by the operational wind farm. The possible exception is for skylark where the direct/indirect impacts of operational turbines on local populations have the potential for a *Low* magnitude of effect the impacts are considered to be of *very low significance*	None	None Possible residual impact for local skylark population of Very Low significance

Receptor	Nature Conservation Importance	Potential Impact Direct/ Secondary	Magnitude / Duration	Significance	Level of Certainty / Comments	Mitigation	Residual Impact
OPERATIONAL PHASE							
Buzzard	Not sensitive	Direct: collision with turbines Secondary: displacement	Negligible Temporary - Long-term (30 years)	Not significant	Relatively high usage of the site means there is high likelihood of collisions with turbines, however in the context of an increasing population, the effect at a population level is considered negligible. There may be displacement effect immediately after construction, however it is considered that buzzards develop a tolerance to turbines over time.	None required Note: Site hygiene measures to be implement to reduce the levels of carrion available on the hill could reduce the usage of the site by buzzards	None Possible residual impact for local buzzard population of Very Low significance
Wintering woodcock	Not sensitive	Direct: collision with turbines Secondary: disturbance	Negligible Temporary - Long-term (30 years)	Not significant	Records of woodcock were limited to wintering birds, which utilise the forestry/scrub within the wind farm site to roost up during the day and are likely to forage in the bog/wet acid grassland during the night. It is considered that any collisions would have a negligible impact on the wintering population. Displacement effect due to loss of forestry cover is not considered to be a factor limiting the occurrence of this species at this location and any displacement effect will be imperceptible.	None required	None
Non-breeding gulls	Low to not sensitive, based on BoCCI4 2020-2026	Direct: collision with turbines Secondary: none	Negligible Temporary - Long-term (30 years)	Not significant	Flocks of non-breeding gulls, including herring gulls, lesser black-back gulls and great black-backed gulls were noted as being attracted to foraging and roosting opportunities at the mink farm c. 4km from the Application Site. Occasionally, flocks or smaller numbers entered the site. Predicted collision risk is not considered to be significant due to the low level of activity within the Application Site	None required	None
DECOMMISSIONING PHASE – POTENTIAL IMPACTS AS DETAILED UNDER CONSTRUCTION PHASE							

10(iii) Bats

CHAPTER 10(iii) IMPACT ASSESSMENT FOR BAT POPULATIONS AT THE PROPOSED GRAFFY WIND FARM, CO. DONEGAL

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DOCUMENT CONTROL

Document	A Bat Survey Report for the Proposed Graffy Wind Farm, Co. Donegal.
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This chapter 10(iii) addresses the assessment of impacts on bats by the proposed Graffy wind farm. The wider biodiversity chapter contains information on different specialist subject areas of ecology, and has been presented in five different sections, written by a number of experts and has been broken down into the following sub-sections:

10(i) flora & fauna

10(ii) avi-fauna

10(iii) bats

10(iv) aquatic ecology

10(v) freshwater pearl mussel

CONTENTS

Appendix 1 referred to in this report is contained in Appendix 9 of the Appendices Volume 3 of the EIAR.

STATEMENT OF AUTHORITY

Bat surveys for Graffy Wind Farm were conducted by Woodrow Sustainable Solution Ltd (Woodrow). Deployment of equipment and bat surveys was undertaken by experienced bat surveyors, including: Rachel Irwin, Hazel Doyle and Mike Trewby. Rachel Irwin and Rachael O'Dwyer processed all the recordings and under the supervision of Will Woodrow they completed the manual classification of all the sound files. The results section was compiled by Rachel Irwin, with Mike Trewby undertaking the ecological assessment, with guidance from Will Woodrow. This document has been reviewed and approved by Róisín NigFhloinn. As members of the Chartered Institute of Ecology and Environmental Management (CIEEM) all Woodrow staff are required to abide by a strict code of professional conduct in all aspects of their work.

Rachel Irwin and Rachael O'Dwyer are both recent university graduates with B.Sc. degrees and joined Woodrow in 2019 as Graduate Ecologists. Hazel Doyle was an Ecologist with Woodrow, prior to taking up a Conservation Ranger position with NPWS in 2019. Since joining Woodrow in 2017, Hazel gained extensive experience undertaking bat surveys on wind farm sites. She is a graduate member of CIEEM and has completed an honours B.Sc. specialising in Zoology (2009-2013) and M.Sc. in Biodiversity and Conservation.

Mike Trewby, is Senior Ecologist with Woodrow and is the company's lead ornithologist and field work manager. He has over 20 years fieldwork and research experience in ecology, including four seasons of supervising and undertaking bats surveys on 17 wind farm sites across Ireland. Mike regularly undertakes impacts assessments for large scale developments. He is a full member of CIEEM and Mike's qualifications include a Post Grad. Dip. in Environmental Studies and a B.Sc. in Zoology & Botany.

Róisín NigFhloinn is a Senior Ecologist with Woodrow and manages several large infrastructure schemes and regularly carries out reporting for EcIA, EIAR Biodiversity Chapters and to inform Appropriate Assessments carried out by statutory authorities. Róisín has more than ten years' experience in habitat surveys, mammal surveys, bird and bat surveys for a number of large infrastructure schemes, commercial and residential projects, as well as being an experienced ECoW. She is a full member of CIEEM and has completed an honours degree, specialising in Botany, and holds a MSc. in Ecology and Management of the Natural Environment.

Will Woodrow is a Director and Principal Ecologist at Woodrow. Will has over 30 years of experience in ecological surveys and assessment, including extensive involvement in bat surveys and assessment for wind farm sites in both the Republic and Northern Ireland. Will is a Chartered Ecologist and a full member of CIEEM. Will's qualifications include M.Sc. –

European Environmental Policy and Regulation and M.Sc. (Arch) – Advanced Environmental and Energy Studies.

1 INTRODUCTION

1.1 Protected status of bats in Ireland

10(iii).1 Bats are protected by law in the Republic of Ireland under the Wildlife Act 1976 and subsequent amendments (2000 and 2010). Under the Wildlife Act, it is an offence to intentionally disturb, injure or kill a bat or disturb its resting place. Under this legislation it is unlawful to destroy, alter or disturb known bat roosts without an appropriate derogation licence, as issued by the National Parks and Wildlife Service (NPWS).

10(iii).2 All bat species fall under Annex IV of the EU Habitats Directive (1992), whereby member states have a burden of responsibility to protect bats and their resting places wherever they occur. The EU Habitats Directive has been transposed into Irish law with the European Communities (Birds and Natural Habitats) Regulations 2011. The lesser horseshoe bat (*Rhinolophus hipposideros*), which occurs only in Counties Cork, Kerry, Limerick, Clare, Mayo and Galway in the Republic of Ireland, is listed in Annex II of the EU Habitats Directive 1992. The level of protection offered to the lesser horseshoe bat effectively means that areas important for this species are designated as Special Areas of Conservation (SACs). For remaining bats, the EU requires that they are strictly protected. Among Ireland's obligations under the Habitats Directive, is the obligation to 'maintain favourable conservation status' of Annex-listed species.

10(iii).3 Ireland has ratified two international conventions, which afford protection to bats amongst other fauna. These are known as the 'Bern' and 'Bonn' Conventions. The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention 1982) exists to conserve all species and their habitats, including bats. The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention 1979, enacted 1983) was instigated to protect migrant species across all European boundaries, which covers certain species of bat.

1.2 Requirements for impact assessment

10(iii).4 In order to comply with the requirements of the EU Habitats Directive 1992 and the EC Habitats Regulations 2011, wind farm applications in Ireland need to be assessed as to their potential impact on bat populations. To inform the impact assessment at the proposed development a range of bat surveys were undertaken including a desk-based study and field surveys. As of 2019 the appropriate methodological approach for assessing bat population on proposed wind farm sites is *Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation* (SNH *et al*., 2019).

2 OUTLINE OF THE SCOPE OF WORKS

2.1 Overview

10(iii).5 In compliance with SNH *et al.* (2019)[1], static bat recording equipment was deployed three times at the proposed turbine locations or at positions considered representative of the proposed layout. The three deployments each lasting a minimum of 10 nights covered the spring, summer and autumn active season for bats and were undertaken in conjunction with continuous monitoring of climatic conditions on the site to ensure recording windows were in line with compliant weather parameters. An assessment of potential bat roost features adjacent to the proposed development was completed, along with roost emergence surveys and bat activity transects.

10(iii).6 Once the baseline bat populations and habitat suitability at the site proposed for development were described, an impact assessment was conducted. This assessment considers the eight-turbine wind farm development proposed for Graffy Hill, Co. Donegal, which is located along the lower southern slopes of An Eachla (Aghla Mountain), *c.* 8 km east of Na Gleannta (Glenties). The central grid reference for the site is IGG 90603-97329 [Lat. 54.8238, Long. -8.1469]. The layout of the Application Site is shown in Appendix I, Figure 1 (see Appendix 9 in Volume 3 of the EIAR) and the proposed wind turbines (WT) are located within the following townlands:

- WT01, WT02 — An Dearachán Mór - Dalraghan More
- WT03, WT04, WT05, WT06 — Min na Manrach - Meenamalragh
- WT07, WT08 — An Ghrafaidh - Graffy

10(iii).7 The grid connection route following the local roads and Coillte tracks to the Tievebrack substation was also assessed, along with selected section of the turbine delivery route where any vegetation removal is proposed to facilitate transportation.

10(iii).8 At the time of the conducting this impact assessment the following information regarding turbine specification was provided:

Turbine Model	Hub Height	Rotor Diameter	Blade Tip Height
Enercon 126	85.94 metres	127 metres	149.44 metres
Nordex 133	83 metres	133.2 metres	149.6 metres

10(iii).9 Please note that although turbine dimensions are specified here, the bat data collected and impact assessment can be adjusted for alternative turbine dimensions, as well as site layout to some extent, e.g. micro-siting of turbines.

[1] Scottish Natural Heritage, Natural England, Natural Resources Wales, Renewable UK, Scottish Power Renewables, Ecotricity Ltd, University of Exeter & Bat Conservation Trust (2019). Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation.

2.2 Layout

10(iii).10 This section of the Biodiversity Chapter provides details of methodologies and survey effort for the suite of bat surveys conducted at the proposed wind farm site during the active bat survey season of 2019 and into 2020. Survey results are summarised in the baseline and a technical appendix provides more detailed survey results – see Appendix 9 in Volume 3 of the EIAR, including tabulated results, maps and charts, as well as reports from roost suitability surveys, bat activity surveys and seasonal static bat detector surveys.

10(iii).11 Bat surveys were designed to provide the baseline information required to conduct an assessment of the potential impacts of the proposed development on bat populations utilising the area. The impact assessment is laid out after the baseline conditions have been described and includes recommended avoidance and/or mitigation measures that should be implemented as part of the design phase of the project.

2.3 Survey limitations

10(iii).12 In the case of bat surveys, survey limitations often relate to weather conditions at the time of the surveying and equipment failing in the field, for example microphones can be damaged by livestock or can lose sensitivity when exposed to prolonged episodes of heavy rainfall. In Ireland good survey conditions for static monitoring sessions are difficult to guarantee, as weather forecasts can change dramatically over the few nights that static detectors are left out and this is especially the case on upland sites like Graffy. However, deployment periods can be considered as capturing data that is representative of the real situation and provide useful insight into the sporadic and opportunistic use of upland sites by bats; for instance, foraging bats may be less inclined to venture up open hillsides on nights when prevailing weather conditions, e.g. higher wind speeds, make flying more energetically costly or supresses activity levels of flying invertebrates upon which bats prey. A primary value of static detectors deployed in conjunction with a weather station, is the ability to compare relative density of use across a site at a time when all variables (such as weather) are the same, rather than just recording during optimal weather conditions for bats.

10(iii).13 To comply with SNH *et al.* (2019), the duration of each deployment period should last a minimum of 10 nights within compliant weather parameters. Compliant weather conditions are defined as: temperatures at ≥ 8°C at dusk, maximum ground level wind speed of 5 m/s (11 mph) and no, or only very light periodic overnight rainfall. An onsite weather station was deployed to monitor climatic conditions and as a precaution deployment periods were generally extended beyond 10 nights, unless recorded weather conditions demonstrated compliance.

10(iii).14 During the 2019 survey period the site layout changed, with the number of turbines dropped from nine to eight and several of the proposed locations were altered. The spring and summer 2019 deployments followed the initial nine-turbine layout, with the autumn 2019 deployment utilising eight units and shifting deployment locations to account for the new eight-turbine site layout. The characteristics of the Graffy site, in terms of features potentially utilised by bats, are remarkably similar across the site and it is therefore considered that while the deployment locations for static recording equipment does not mirror the final turbine layout exactly, ***the deployment patterns employed over the 2019 active bat season do provide representative baseline data to facilitate a robust assessment of potential impacts of the proposed wind farm on bat population utilising the area.***

10(iii).15 Figure 7 in Appendix I shows the deployment pattern for each season in relation to the final turbine layout and **Table 2** provides details on deployment dates, duration and habitat features covered including closest turbine(s). The seasonal static detector reports in the bat appendix in Appendix 9 in Volume 3 of the EIAR, examine each seasonal deployment period in terms of the number nights when data was captured and compliance with weather parameters. The following potential limitations were noted:

Spring static deployment

- Extending the 'spring' survey window into June was considered appropriate as Graffy is an upland site.
- In order to determine compliance with weather parameters, 'substitute' weather data from several Met Éireann sources had to be used up until 17-Jun-2019, as poor 3G coverage over Graffy resulted in the on-site weather station failing to transmit data consistently until it was re-located. Figure 7 in the bat appendix in Appendix 9 in Volume 3 of the EIAR, shows the final location of the weather station.
- The unit covering T8 (D.09) stopped recording on the fifth night. Fortunately, additional representative coverage of habitats in the southwest of the site was provided by two units deployed to the north and south of T8 (D.10 and D11).
- Windy conditions were recorded over the spring deployment pushing some nights beyond compliant levels. However, elevated wind speeds are considered a feature of this upland site and overall, 10 nights within acceptable limits were achieved. Data recorded during periods when wind speeds exceeded compliant levels were not excluded from the analysis, as bats were found to remain active during all but the windiest conditions.

10(iii).16 It is considered that the spring deployment provides sufficient baseline data to facilitate a robust assessment of potential impacts of the proposed wind farm.

Summer static deployment

- Nine static units were deployed for the summer deployment and most of the units recorded for 11 consecutive nights, with the exception of one unit which recorded for 10 nights.

- Only one night clearly exceeded compliant weather parameters, when mean hourly wind speeds gradually increased from 6.7 m/s to 15.6 m/s. Gusty conditions and prolonged spells of light rainfall on other nights also tested the bounds of compliance with weather parameters; however, it is considered that overall, 10 nights within acceptable limits were achieved.

10(iii).17 It is considered that the summer deployment provides sufficient baseline data to facilitate a robust assessment of potential impacts of the proposed wind farm.

Autumn static deployment

- Eight units were deployed for the autumn deployment, four units recorded for 13 nights and due to the longer recording nights, batteries became depleted in the other four units after 10 nights of recording.
- Wind speeds exceeded compliant levels on several nights, with rainfall also experienced. However, in the context of wind speeds for the time of year and in view the of upland nature of the site, the majority of nights were compliant with the weather parameters (8 out 10 nights with simultaneous recordings for all eight static units deployed) and it is considered that overall, 10 nights of representative data were achieved.

10(iii).18 It is considered that the autumn deployment provides sufficient baseline data to facilitate a robust assessment of potential impacts of the proposed wind farm.

Roost surveys

- Roost emergence surveys were undertaken at three abandoned cottages occurring within the 266 m Zone of Influence around the proposed turbines. These structures had been identified as having '*moderate*' or '*moderate to high*' potential for supporting maternity roosts, as detailed in Colins (2016)[2]. A full building inspection under licence was undertaken on one of the structures during Feb-2021 (Structure 1) which returned an inconclusive result and while no hibernacula were identified, not all features within the building could be accessed. The other buildings are considered to be sufficiently distant from the proposed turbine locations, so as not to require further building inspections for hibernation roosts and the current non-invasive building inspection will suffice.

Bat activity transects/ point count

- Bat activity transects are no longer a mandatory requirement under the SNH *et al.* (2019) guidelines and such survey work should be carried out according to professional judgement on the suitability of the site for bats. Transects were undertaken covering the summer and autumn, as it is considered that these can provide valuable context for the data recorded by static detectors, e.g. identifying approximate numbers and behaviours of bats.

10(iii).19 In conclusion, the surveys conducted over the 2019 and 2020 active bat survey periods, as well as hibernation roost inspections (Feb-2021) are considered compliant with the SNH *et al.* (2019) guidelines. It is considered that the survey approach and coverage was sufficient in order to gain a full insight into the use of the site by bats and provides adequate

[2] Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edition). The Bat Conservation Trust, London.

information to assess any potential impacts of the proposed wind farm development on populations.

Note: Given the proximity of an abandoned cottage to the proposed location of T4 and the discovery of a transitional roost (suspected Myotis species), continued roost monitoring will be undertaken at this location. A dusk survey was undertaken at this cottage again on 17-May-2021 and a small number of *Myotis* species (1-2 bats) were recorded leaving the roost.

3 SURVEY METHODOLOGY

10(iii).20 Pre-planning surveying for bats at proposed wind farm sites aim to identify the species occurring within the proposed development area and provide an understanding of how local bat populations utilise the area in terms of density of use for foraging, roosting (maternity and hibernation) and social interactions. This information allows for the identification and assessment of the potential impacts the proposed development is likely to have and for appropriate avoidance and/or mitigation measure to be implemented as part of the design phase of the project.

10(iii).21 Bat surveys were conducted by Woodrow Sustainable Solutions Ltd. at Graffy over the 2019 active bat season to ensure compliance with the most recently published guidelines pertaining to surveying, impact assessment and mitigation for bats at onshore wind turbines (SNH *et al.*, January 2019)[3]. This guidance document supersedes previous guidelines (Collins, 2016[4] updating Hundt, 2012[5] & BCI, 2012[6]) and requires a site by site approach to survey design, with the only prescriptive element being the positioning, number and duration of static bat detector deployments, as well as the strongly recommended continual monitoring of site-specific weather data on rainfall, temperature and wind speeds.

10(iii).22 The latest guidelines require as a minimum three deployments of static detectors aimed at covering spring (Apr-May), summer (Jun-mid-Aug) and autumn (mid-Aug-Oct), each with a minimum deployment period of 10 nights (within compliant weather parameters), with detectors placed at all known turbine locations for proposals containing less than ten turbines, as is the case for Graffy Wind Farm. Compliant weather conditions are defined as: temperatures at ≥ 8°C at dusk, maximum ground level wind speed of 5 m/s (11 miles/hr) and no, or only very light, periodic rainfall.

10(iii).23 Additional requirements of the SNH *et al.* (2019) guidelines include swarming surveys and winter roost inspections, if potential hibernation roosts are identified. Transect and/or vantage point surveys are seen as methods used to complement the static detector surveys, with applicability being discretionary and site-specific.

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[3] Scottish Natural Heritage, Natural England, Natural Resources Wales, Renewable UK, Scottish Power Renewables, Ecotricity Ltd, University of Exeter & Bat Conservation Trust (2019). *Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation.*

[4] Collins, J. (ed.) (2016) *Bat Surveys for Professional Ecologists: Good Practice Guidelines* (3rd edition). The Bat Conservation Trust, London.

[5] Hundt, L. (2012). *Bat Surveys: Good Practice Guidelines*. 2nd Edition. BCT– Bat Conservation Trust, London.

[6] Bat Conservation Ireland (2012) Wind Turbine/Wind Farm Development Bat Survey Guidelines, Version 2.8, December 2012. Bat Conservation Ireland

3.1 Desk-based surveys

10(iii).24 Desk based review of habitat availability in the environs of the site and available bat data were used to inform the scope to the bat surveys required. As recommended by both BCI (2012) and SNH *et al.* (2019) the area covered by the desk-based review was extended to 10 km surrounding the application boundary for the site. The desk-based study included:

- Reviewing distances from closest Natura 2000 sites designated for bats (only bat SACs in Ireland are for lesser horseshoe bat *Rhinolophus hipposideros*) - the area of interest (in Co. Donegal) is outside the range for lesser horseshoe bat in Ireland.
- Examining aerial imagery and 6-inch maps to identify potential bat foraging and roosting habitats
- Lundy *et al.* (2011)[7] provides a high-level assessment of potential habitat suitability for different species of bat occurring in Ireland.
- Review of data received from BCI for 10-km squares encompassing the site [G89 & G99] and the results of Biodiversity Maps report for the same 10-km squares, including species recorded and known roosting sites.

3.2 Roost assessment surveys

10(iii).25 The most recent guidelines (SNH *et al.*, 2019) recommend that "features that could support maternity roosts and significant hibernation and/or swarming sites (both of which may attract bats from numerous colonies from a large catchment) within 200 m plus rotor radius of the boundary of the proposed development should be subject to further investigation".

10(iii).26 Given the proposed turbine specification for Graffy (rotor radius 66 m) a search area of 266 m was applied to the eight-turbine layout, as shown in Figure 1 in Appendix I (see Appendix 9 in Volume 3 of the EIAR). Turbine specification, as well as locations are regularly altered during the design phase of projects and as a precaution Woodrow always conduct roost assessment surveys within the 300 m of potential build area. Features along the grid connection route (within *c*. 30 m) were also assessed in September 2020. Surveyors utilised the assessment criteria described in Collins (2016)[8] – see Page 35, Table 4.1, which provides guidelines for assessing potential suitability of habitat features as bat roosts and for foraging bats.

10(iii).27 Surveyors employed non-invasive external and internal inspection techniques for buildings and trees were assessed from the ground. Based on the young age of trees, a lack of suitable Potential Roost Features (PRFs), and species composition (mostly Sitka spruce) it can safely be assumed that conifer trees within plantations did not support roosting bats.

[7] Lundy, M.G., Aughney, T., Montgomery, W.I., & Roche, N., (2011) Landscape conservation for Irish bats & species specific roosting characteristics. Bat Conservation Ireland

[8] Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edition). The Bat Conservation Trust, London.

Based on the findings of the roost inspection on other structures in the vicinity of the proposal, features classed as having moderate to high suitability for bats and/ or demonstrating likely occupancy, (e.g. bat dropping found) were targeted for further surveys, including dusk emergence surveys.

10(iii).28 Informed by the discovery of a transitional roost at Structure 1, adjacent to T4 in Sep-2020 a full building inspection (under NPWS licence) was undertaken at this abandoned cottage on 11-Feb-2021 to investigate the occurrence of any hibernation roosts. Outer walls were fully examined with the use of an endoscope and a thermal imaging camera. Crevices in the wooden cladding inside the building were also examined; however, no internal features could be accessed.

3.3 Bat activity surveys - roost emergence/ re-entry surveys

10(iii).29 Based on the findings of the building inspection conducted in 2019 and updated in 2020, roost emergence/ re-entry surveys emergence surveys were undertaken at three of the structures within the 266 m search area that were identified as having moderate or moderate to high potential for supporting roosting bats. This included the structures numbered 1, 6 and 14, as shown in Appendix I-Figure 2 (see Appendix 9 in Volume 3 of the EIAR). Structures 1, 6 and 14 were in the potential ZoI - Zone of Influence (266 m turbine buffer) of T4, T7 and T8 respectively. Potential access points for bats on the roost features were covered, employing up to two surveyors using professional Elekon Batlogger M bat detectors to record any bat activity.

10(iii).30 Emergence surveys were undertaken at selected features within the Zone of Influence on 23-Jul-2019, 08-Aug-2019 and 15-Sep-2020, prior to commencing site walkovers and covered the period of time from *c.* 15-30 minutes before sunset and lasting up to *c.* 1 hour after sunset. As shown in **Table 1**, Structure 1 (ZoI T4) and Structure 14 (ZoI T8) were surveyed on 23-Jul-2019 and Structure 6 (ZoI T7) was covered on 07-Aug-2019. Repeat emergence surveys were conducted simultaneously at Structures 1 and 6 on 15-Sep-2020. Another dusk emergence survey was conducted on Structure 1 on 17-May-2021.

3.4 Bat activity surveys – walked/ driven transects and point counts

10(iii).31 Transect surveys were undertaken using professional Elekon Batlogger M bat detectors to collect geo-referenced records of bat activity. Following on from roost emergence surveys, walked transects were undertaken on 23-Jul-2019 and 07-Aug-2019, with a combination of walked/ driven transects and point counts employed on 15- Sept-2020, when the grid connection route was also surveyed.

10(iii).32 Survey dates and weather conditions for transects conducted in 2019 are provided in **Table 1** below, with survey locations and transect routes shown in Appendix I- Figures 3, 4, 5 and 6 (see Appendix 9 in Volume 3 of the EIAR). Temperature and wind speed were measured at intervals throughout the survey using a Silva hand held weather meter. Field records were made of bat species encountered, number of bat passes, activity (where known: e.g. foraging, commuting, advertising), travelling direction and approximate height (where known).

3.5 Static detector surveys

10(iii).33 Static detector surveys were undertaken using Song Meters (SM2 or SM4) on three occasions cover spring, summer and autumn. Static bat detectors are deployed to record the types of bat species present and to provide an overview of how bat activity is broadly distributed over the site. As described in the limitation section static bat detectors were deployed at, or as close as feasible, to each of the eight turbine locations proposed for the Graffy Wind Farm. Figure 7 in Appendix I (see Appendix 9 in Volume 3 of the EIAR) shows the deployment pattern for each season in relation to the final turbine layout and **Table 2** below provides details on deployment dates, duration and habitat features covered including closest turbine(s).

3.6 Monitoring climatic conditions

10(iii).34 Monitoring climatic conditions was undertaken through the deployment of an on-site fully automated weather station with 3G connectivity. The Davis Vantage Vue wireless integrated sensor suite weather station deployed at Graffy, provided data on a real-time basis. This allows weather station functionality to be checked on a daily basis during the survey season and for action to be taken if a station fails or there are concerns regarding the data. This obviates the need for a second (backup) weather station. The weather station collected the full range of weather data, including temperature, wind speed and rainfall, which allows surveyors to determine whether deployments nights were compliant with the weather parameters (≥ 8°C at dusk, max. ground level wind speed of 5m/s and minimal rainfall).

10(iii).35 Deployment periods can then be adjusted to ensure 10 nights of compliant data are captured. In addition, site specific weather data can be useful for investigating the recorded patterns of site usage by bats, for instance exposed upland sites can receive an influx of foraging bats during nights that are warm and relatively still, especially towards the end of the summer and into the autumn as bats disperse from maternity roosts.

10(iii).36 The location at which the weather station was deployed is show in Appendix I-Figure 7 (see Appendix 9 in Volume 3 of the EIAR)

3.7 Calibration and testing of recording equipment

10(iii).37 Calibration and testing of recording equipment is required by SNH *et al.* (2019), and as a standard operating procedure Woodrow have a stringent schedule of testing all bat recording equipment prior to and during deployment in the field. Checks are logged in excel, providing an audit trail to ensure that all data can be relied on and form a robust and defendable data set. Unique numbering of static detectors, SD cards and microphones allows for reverse checking, if any issues arise, e.g. following a microphone failure. Checks undertaken include pre-deployment device setting and battery checks, and post- and pre- deployment microphone sensitivity checks. As detailed in the section on survey limitations, failure of bat recording equipment was limited to premature battery depletion in a single unit, resulting in only five nights being recorded for T8 during the June (spring) deployment in 2019. The initial deployment of the weather station experienced technical difficulties, due to poor network connection; however, the situation was remedied by 17-Jun-2019, when the unit was re-located to a position with a stronger signal.

3.8 Analysis

10(iii).38 Analysis of sound recordings collected using EM3s, SM2s and SM4s was undertaken using Kaleidoscope software to confirm species (or genus for *Myotis* species) and the number of bat passes for each transect survey or deployment. For data collected using the Batloggers, analysis of sound recordings was undertaken using BatExplorer software. Russ (2012)[9] and Middleton *et al.* (2014)[10] were used to aid in identification of bat calls during data analysis.

Table 1. Transect and roost survey dates, timing and weather conditions

Date	Start time	End time	Survey type	Weather Conditions
23-Jul-2019 Sunset 21.54	21:32	22:48	Emergence survey at T4 cottage – Structure 1	Wind: F. 4-5 NNW Cloud: 4 to 6 oktas Dry Temp: 18 to 17°C
	21:32	22:48	Emergence survey at T8 cottage – Structure 14	Wind: F. 4 NNW Cloud: 4 to 6 oktas Dry Temp: 18°C
	22:48	00.59	Dusk transect – From T4 area covering middle plantation, then T1 & T2	Wind: F. 4-5 NNW Cloud: 4 oktas Dry Temp: 18°C
07-Aug-2019 Sunset 21:25	20.55	22:25	Emergence survey at T7 cottage – Structure 6	Wind: F. 2 Cloud: 6 to 8 oktas Dry Temp 14 to 13°C
	22.25	23:02	Dusk transect – From area below T7 to T6 & middle plantation	Wind: F 2 Cloud: 8 oktas Dry, occ. drizzle Temp: 13°C
15-Sep-2020 Sunset 19:46	19:30	21:00	Emergence surveys at T7 cottage/ tree – Structure 6	Wind: F 1 Cloud: 8 oktas Dry Temp: 17 to 16°C
	21:05	22:05	Point count at recent burnt house – Structure 9	Wind: F 1 Cloud: 8 oktas Dry Temp: 16°C
	19:30	21:00	Emergence surveys at T4 cottage – Structure 1	Wind: F 0 Cloud: 8 oktas Dry Temp: 17°C
	21:00	21:15	Dusk transect – Short transect from T4 to burnt house below T7 (Structure 9)	Wind: F 0 to 1 Cloud: 8 oktas Dry Temp: 16°C
	22:05	22:45	Driven transect – grid connection route along road from burnt house to opposite Teivebrack Substation	Wind: F 1 Cloud: 8 oktas Dry Temp: 16 to 17°C
17-May-2021 Sunset 21:37	21:14	23:47	Emergence survey at T4 cottage – Structure 1	Wind: F 2 Cloud: 1 okta Dry Temp: 14 to 7°C

[9] Russ, J., Briggs, P. & Wembridge, D. *The Bats and Roadside Mammals Survey 2008. Final Report on Fourth Year of Study.* The Bat Conservation Trust and People's Trust for Endangered Species, London.

[10] Middleton N., Fround A. & French K (2014) Social Calls of the Bats of Britain and Ireland.

Table 2. Static bat detectors - deployment dates, duration, location, associated turbine number, unit ID code and habitat features covered.
NOTE: Number of compliant nights (recording minutes) used to generate bat passes per hour are shown in results tables in Appendix I (see Appendix 9 in Volume 3 of the EIAR)

Map ID	Associated turbine No.	Unit location (Lat.-Long.)	Associated features/ habitats	Spring deployment date: 13-Jun-19		Summer deployment date: 01-Aug-19		Autumn deployment date: 26-Sep-19	
				Unit code	Running time (mins)	Unit code	Running time (mins)	Unit code	Running time (mins)
D.01	T1 & T2	54.83138806 -8.13567184	Open - Sheep grazed upland blanket bog *c.* 80 m out from plantation (located between T1 & T2)	WSS-006	14 nights (6,630)	WSS-022	10 nights (6,037)	WSS-002	13 nights (11,284)
D.02	T1 (representative of mitigation)	54.83071400 -8.12996700	Open - Upland blanket bog/ heath with bare rock & bog pools *c.* 60 m from plantation (located *c.* 280 m S of T1)	no deployment	-	no deployment	-	WSS-006	10 nights (9,547)
D.03	T3	54.82783983 -8.14286547	Open - Sheep grazed upland blanket bog/ wet grassland *c.* 350 m from plantation (located *c.* 200 m E from T3)	WSS-022	14 nights (6,630)	WSS-003	11 nights (6,303)	WSS-009	10 nights (9,304)
D.04	T4	54.82311500 -8.14621400	Open - Sheep grazed wet/ semi-improved grassland *c.* 70 m from group of trees surrounding abandoned house (located *c.* 90 m SSE of T4)	WSS-016	14 nights (6,630)	WSS-017	11 nights (6,303)	WSS-007	10 nights (9,335)
D.05	T5 - new	54.82027300 -8.15331500	Open - Sheep grazed upland blanket bog/ wet grassland *c.* 40 m from plantation (located *c.* 100 m SW of T5)	no deployment	-	no deployment	-	WSS-196	13 nights (11,284)
D.06	T6	54.82506400 -8.15478000	Open - Sheep grazed upland blanket bog *c.* 100 m out from plantation (located *c.* 80 m NNW of T6)	WSS-017	14 nights (6,630)	WSS-006	11 nights (6,303)	no deployment	-
D.07	T6/ T5	54.82242266 -8.15692871	Open - Sheep grazed upland blanket bog/ wet grassland *c.* 350 m from plantation (located *c.* 275 m from T5 & *c.* 300 m from T6)	WSS-019	14 nights (6,630)	WSS-018	11 nights (6,303)	WSS-022	10 nights (9,358)
D.08	T7	54.81809813 -8.15913688	Open - Sheep grazed upland blanket bog/ wet grassland *c.* 60 m from ruin surrounded by trees (located *c.* 125 m SW of T7)	WSS-021	14 nights (6,630)	WSS-007	11 nights (6,303)	WSS-188	13 nights (11,284)
D.09	T8	54.81319573 -8.16344247	Open - Sheep grazed wet heath/ blanket bog/ rushy grassland (located *c.* 90 m SW of T8)	WSS-005	5 nights (2,081)	WSS-001	11 nights (6,303)	WSS-195	13 nights (11,284)
D.10	T7/T8 (context for SW)	54.81653900 -8.16763400	Weak feature - Slight depression b/t mounds of heather, *c.* 10 m from small seasonal stream & wetland area (located *c.* 450 m from T8 & *c.* 480 m from T7)	WSS-018	14 nights (6,630)	WSS-002	11 nights (6,303)	no deployment	-
D.11	T9 - dropped (context for SW)	54.81287178 -8.15701615	Open - Degraded blanket bog/ rushy grassland adjacent to met. mast (located *c.* 360 m ESE of T8)	WSS-004	14 nights (6,630)	WSS-008	11 nights (6,303)	no deployment	-

4 BASELINE CONDITIONS

10(iii).39 The pre-planning bat surveys undertaken for the proposed Graffy Wind Farm over 2019 and including additional roost surveys 2020 and 2021 give an understanding of how bats utilise the area. This section covering the baseline conditions for the Application Site provides an overview of the main findings, based on the detailed results of bat surveys, as fully described in Appendix I (see Appendix 9 in Volume 3 of the EIAR). This technical appendix provides detailed survey reports for the three seasonal deployments of static bat detectors, bat activity transects/ point counts and roost surveys, which are accompanied by data analysis presented in tables, charts and maps.

10(iii).40 Bat passes per hour (bp/h) are used to assess levels of bat activity during surveys, as this provides a relative measure of activity based on survey time, e.g. duration of static bat detector deployment, transect duration or the time spent undertaking a point count. Bat activity measured as bp/h is considered to be a useful proxy for assessing the potential collision risk posed by new wind farm sites. In order to provide a context to levels of activity, the data recorded for Graffy has been presented taking account of a Polish study by Kepel *et al.* (2011)[11]. This study sought to attribute significance levels to bat activity recorded during wind farm surveys by categorising different levels of detected bat activity as low, medium or high activity. As illustrated in **Table 3**, for the purpose of wind farms in Ireland, the activity levels of the Polish study can be adapted into bands representing low, medium, and high levels of bat activity. The rationale for employing the criteria developed by Kepel *et al.* (2011) are discussed further in Section 4 of Appendix I

Table 3. Bat activity levels associated with bat passes per hour (bp/h) - Kepel *et al.* (2011).

Attributed activity level	*Nyctalus* species	Pipistrelle species	All bats
Low	0.0 to 3.5	0.0 to 3.5	0.0 to 4.0
Medium	3.6 to 6.5	3.6 to 6.5	4.1 to 10.0
High	> 6.5	> 6.5	> 10.0

[11] Kepel, A., Ciechanowski, M. & Jaros, R. (2011). How to assess the potential impact of wind turbines on bats using bat activity surveys? A case study from Poland, XII European Bat Research Symposium, August 22-26, 2011, Vilinusm Lithuania.

4.1 Desk based study

4.1.1 Historical data review

10(iii).41 For the desk-based study, Table 2 in Appendix I (see Appendix 9 in Volume 3 of the EIAR) lists the data received from Bat Conservation Ireland (BCI) for the 10-km squares [G89, G99] encompassing the Application Site and shows that six species occur within the vicinity of the Application Site, including:

- Common pipistrelle *Pipistrellus pipistrellus*
- Soprano pipistrelle *Pipistrellus pygmaeus*
- Leisler's bat *Nyctalus leisleri*
- Brown long-eared bat *Plecotus auritus*
- Daubenton's bat *Myotis daubentonii*
- Natter's bat *Myotis nattereri*

10(iii).42 The only Natura 2000 sites designated for bats in Ireland are for lesser horseshoe bats (*Rhinolophus hipposideros*). The area of interest in Co. Donegal is outside the range for this species; and with the closest Special Areas of Conservation (SACs) being in Co. Mayo, there are no designate sites within the 15 km Zone of Influence of the proposed wind farm at Graffy.

10(iii).43 A review of the roost records received from BCI found that none were located within the Application Site and all were beyond the Zone of Influence (266 m) of the proposed turbine locations. Note: As required by the BCI, the exact locations of roosts are not provided, due to the sensitivity of the information and because roosts are often associated with private properties.

4.1.2 Potential habitat suitability for bats

10(iii).44 Based on Lundy *et al*., (2011)[12], the overall suitability for the 5x5 km squares encompassing the proposed wind farm have been scored as holding habitats of low suitability for all bat species combined. For individual species, habitat suitability was ranked low for all species, with the exception of soprano pipistrelles and for this species habitat suitability was scored moderate-low.

10(iii).45 In terms of observed potential habitat suitability for bats, the turbine envelope (defined, as a 266 m Zone of Influence - ZoI around the proposed eight proposed turbines) would be considered an upland site, with the majority of the ZoI surrounding turbines T1 to T6 lying at altitudes of between 210 m to 300 m asl. The ZoI around T8 at the southwestern end of the Application Site rises up from edge of Stracashel River valley at 170 m to the top of

[12] Lundy, M.G., Aughney, T., Montgomery, W.I., & Roche, N., (2011) Landscape conservation for Irish bats & species specific roosting characteristics. Bat Conservation Ireland

Graffy Hill at 287 m asl, which is within the ZoI of T7. Woodrow's experience of surveying upland locations for bat has found that although bats are regularly recorded at higher elevations, these areas are typically less heavily utilised than lower lying land, due the open and exposed nature.

10(iii).46 Habitat types throughout the turbine envelope are dominated by a mosaic of heavily sheep grazed upland blanket bog, wet heaths and 'rough' grassland, with some smaller areas of semi-improved grassland occurring on the lower slopes, closer to the main road, e.g. around T4. The road itself, which was punctuated with small coppices and patches of scrub, typically around abandoned cottages, was noted as providing potential patches of foraging habitat and weak NE-SW connectivity along the southern extent of the turbine envelope.

10(iii).47 Most of the ZoI was regarded as open and exposed, lacking strong habitat features typically associated with bats, like hedgerows and treelines. However, the undulating terrain, small upland streams and earth banks may provide some weak features and the Application Site, being situated on the southern slopes of Aghla Mountain, would be expected to be more sheltered during periods with northerly winds. This is particularly the case at the southwestern end of the site, where the pronounced west facing lower slopes of Graffy Hill and the influence of the Stracashel River valley would be anticipated to provide some of the more sheltered areas.

10(iii).48 A patchy Sitka spruce plantation cuts through the middle of the site and has numerous grassy/ heathy rides and unplanted patches, which along with the forestry edge provides one of the stronger habitat features within the turbine envelope. Another Sitka spruce plantation forms the north-eastern boundary of the Application Site, again providing forestry edge and some young secondary rotation plantation. Proposed turbine locations for T2, T3, T7 and T8 are positioned in open habitat, with the proposed locations for T4, T5 and T6 being positioned closer to the edge of the forestry plantations. In some instances, the rotor swept area will be within 50 m of the forestry and felling will be required to maintain appropriate standoff distances between turbines and potential bat features. The location of T1 is positioned within an area of notably patchy *c.* 25-year-old Sitka spruce plantation. The patchy nature of this area appears to be due to crop failure in parts, and the shallow forestry drains have resulted in relatively dense stands of ling heather developing in areas between the closed-thicket canopy. The resulting habitat structure provides a multitude of edge effects with potential foraging opportunities for bats.

10(iii).49 Connectivity to the surrounding landscape was visually assessed from aerial imagery and during site walkovers and was considered as relatively weak; although the close proximity of the Stracashel River valley running parallel to the application site may influence the occurrence of bat on the uplands of Graffy Hill. The proposed grid connection route follows the downstream course of the Stracahel River to the Teivebrack ESB Station and there was plentiful suitable areas of foraging habitat, as well as potential roosts.

4.2 Main findings of bat surveys

10(iii).50 Bat activity was recorded within the survey area for a minimum of five species, including common pipistrelle, soprano pipistrelle, Leisler's bat, brown long-eared bat and *Myotis* species.

10(iii).51 As highlighted by Table 6 in Appendix I (see Appendix 9 in Volume 3 of the EIAR), levels of bat activity within the survey area for all species, all the deployment locations and across all three seasons was categorised as ***low***. The low volume of bat passes makes it difficult to decern any clear patterns of site usage.

10(iii).52 As shown in **Table 4**, over the three seasons combined the static detectors (deployed at nine to eight locations) recorded a total of 322 bat passes over *c*. 3,238 hours, which equates to 0.1 bat passes per hour for the survey area as a whole.

10(iii).53 For the June deployments a minimum of five species were recorded, with the highest levels of bat activity, both in terms of bat passes and distribution records, being recorded for common pipistrelle and *Myotis* species. Bat activity, although low was recorded at 8 out of 9 deployment locations.

10(iii).54 For the August deployments a minimum of five species were recorded, with the highest levels of bat activity, both in terms of bat passes and distribution of records, being recorded for Leisler's bats and common pipistrelles. Bat activity, although low was recorded at all the deployment locations.

10(iii).55 For the September-October deployment a minimum of three species were recorded, with the highest levels of bat activity being recorded by soprano pipistrelles (17 passes), although this was only marginally higher than those recorded for common pipistrelles (10 passes) or *Myotis* species (9 passes). No brown long-eared or Leisler's bat were recorded during the autumn deployment. Bat activity, although low was recorded at 5 out of 8 deployment locations.

10(iii).56 An examination of the spread of records over deployment periods for specific locations, found that the limited numbers of bats passes recorded per night (0 to 6 passes) were usually well distributed across the deployment period, with no bats detected on some nights This was indicative of bats moving through the area adjacent to deployment locations, rather than remaining for prolonged periods to forage in the vicinity of turbine/ deployment locations.

10(iii).57 The pattern of use by different species of bat was described as low and sporadic. This would be considered typical for upland sites, where bats will often be detected periodically, exploiting foraging/commuting opportunities over a constrained period and this behaviour is often related to weather conditions, which affects prey availability.

10(iii).58 The final deployment of static bat detectors covering autumn, involved shifting some of the deployment location to surveying a modified site layout. Two static units were deployed 50 to 70 m out from the forestry plantation and covered locations near the final positions of T1 and T5 (Deployment location: D.02 and D.05). Although bat activity was low at these locations, the highest levels of bat activity over the autumn deployment period were recorded by these two units, along with the unit covering T4 (D.04), which was also adjacent to plantation, as well as a small wood and an abandoned cottage.

10(iii).59 Based on static deployments and transects surveys, bat activity was found to be most strongly associated with lower, more sheltered elevations and closer to features such as conifer plantation, upland streams and derelict buildings.

10(iii).60 There was some evidence that the southwestern part of the site might attract higher levels of activity than other more exposed locations across the middle and north-eastern sections of the site, especially during periods with stronger easterly and northerly airflows. The pronounced west facing lower slopes of Graffy Hill and the influence of the Stracashel River valley were considered to provide the most sheltered areas with ample foraging habitat and strong connectivity to the surrounding landscape.

10(iii).61 Results of the roost assessment are provided in Appendix I-Figure 2 and Table 5 (see Appendix 9 in Volume 3 of the EIAR), along with roost survey reports. In the vicinity of the Application Site a total of 18 buildings and two trees were assessed for roost potential. Five of the buildings were assessed as having moderate or moderate to high roost potential. Of these only three buildings and a tree were considered to be within the 266 m Zone of Influence (ZoI) of the proposed turbines.

10(iii).62 Despite there being a number of abandoned cottages with moderate to high roost potential in the vicinity of the Application Site, there were no maternity roosts located during emergence surveys conducted at structures within the 266 m ZoI around proposed turbine locations. Two of the roosts (Structures 6 and 14) were right on the edge of the ZoI for T7 and T8. While there was evidence of bats utilising Structure 6 (droppings recording), no bats were recorded roosting during two emergence surveys.

10(iii).63 An emergence survey in Jul-2019 conducted at Structure 1 (near T4) did not observe any roosting bats. A repeat emergence survey conducted at Structure 1 in Sep-2020 recorded three unidentified bats emerging at 20:09, 20:12 and 20:15. No echolocation calls were recorded and these may have been brown long-eared bats or *Myotis* species. This confirmed this structure as supporting a small transitional roost. Based on a pre-dusk emergence time (dusk approx. 20:30) and the later detection of foraging *Myotis* species in vicinity of the roost (7 passes recorded between 20:28 and 20:42) it was judged most likely to be a transitional roost occupied by *Myotis* species, possibly males, as these are known to roost in small numbers together (Roche *et al.*, 2014)[13]. A subsequent emergence survey conducted in May-2021, identified a small spring transitional *Myotis* species roost supporting *c.* 2 bats. Again, emerging bats were silent and no echolocation calls were detected.

10(iii).64 Structure 1, like many abandoned buildings in the area may not be wholly suitable as a hibernation roost; as the tin roof is poorly insulated (old thatch) which combined with south facing aspect, may not provide the more stable temperatures required by hibernating bats during the winter months. Nevertheless, given the proximity of the cottage to T4, a building inspection was undertaken on 11-Feb-2021 to determine occupancy of hibernating bats. The building inspection was inconclusive, in that no bats were recorded. However not all parts of the cottages could be fully surveyed. Therefore, although no bats were found in the features accessed, this building has the potential to sustain a low number of hibernating bats in some of the crevices that could not be examined. A

10(iii).65 Structure 6 was the most intact building surveyed and was consider to have the most potential to act as a hibernation roost, with access into an attic space noted. However, both structure 6 and 14 were considered to be sufficiently removed from the proposed turbine location (at the edge of the 266 m ZoI), so as not to require further building inspections. Structures 6 and 14 were *c.* 45 m and *c.* 20 m, respectively from the section of the Application Site covering the grid connection route. Even though Structure 14 falls within 30 m potential ZoI, it was considered given the limited scale, constrained nature and distance from the proposed works that this structure would not be directly impacted during construction.

10(iii).66 The proposed grid connection route was surveyed for roost potential and a driven transect was undertaken. Several potential roost locations were identified, as shown in Appendix I-Figure 2 (see Appendix 9 in Volume 3 of the EIAR) and assessment of roost potential is provided in Table 5.

10(iii).67 As shown in Appendix I-Figure 6 (see Appendix 9 in Volume 3 of the EIAR), the driven transect covered part of the grid connection route and mostly recorded common and soprano pipistrelles foraging along treelined sections of the road, with a single pass of a Leisler's bat recorded towards the end of the transect.

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[13] Roche, N., Aughney, T., Marnell, F. & Lundy, M. (2014). Irish Bats in the 21st Century. Bat Conservation Ireland, Cavan, Ireland

Table 4. Bat passes recorded for each species during seasonal deployment of static detectors

Deployment	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	*Myotis* sp.	Total
Spring: Jun-2019	12	43	6	11	42	**114**
Summer: Aug-2019	53	48	31	20	20	**172**
Autumn: Sep. to Oct-2019	0	10	17	0	9	**36**
Total	**65**	**101**	**54**	**31**	**71**	**322**

4.3 Species activity within the site

10(iii).68 A minimum of five bat species were recorded within the survey area across the active season, including: common pipistrelle, soprano pipistrelle, Leisler's bat, brown long-eared bat and *Myotis* species.

4.3.1 Pipistrelle species

10(iii).69 As shown by Table 6 in Appendix I (see Appendix 9 in Volume 3 of the EIAR), low levels of pipistrelle species were recorded throughout the survey area and during all seasonal deployments in 2019. The number of common pipistrelle registrations was higher than that of soprano pipistrelles in both the spring deployment (43 vs 6 passes) and summer deployment (48 vs 31 passes); however, registrations of soprano pipistrelles were nearly double that of common pipistrelles during the autumn deployment (10 vs 17 passes). No Nathusius' pipistrelles were detected and this species is not commonly recorded from Co. Donegal.

4.3.2 Leisler's bat

10(iii).70 As shown by Table 6 in Appendix I (see Appendix 9 in Volume 3 of the EIAR), low levels of Leisler's bat activity were recorded by the spring and summer deployments, and while this species registered the highest number of passes for the summer deployment (53 passes), activity levels were lower during the spring deployment (10 passes) and none were detected during the autumn deployment. The drop off in activity for Leisler's bat during the autumn was also evident during the transect surveys, when they were less frequently recorded during the August and September transects, than in the summer during transects undertaken in July.

4.3.3 *Myotis* species

10(iii).71 As shown by Table 6 in Appendix I (see Appendix 9 in Volume 3 of the EIAR), activity for *Myotis* species was low throughout the active season, with a peak in registrations over the spring deployment (42 bat passes) and less activity recorded during summer (20 passes) and autumn deployments (9 passes). Of the *Myotis* species occurring in Ireland Daubenton's bat is the most commonly occurring and is strongly associated with water courses, like the Stracashel River. Natterer's bat has been recorded from 10-km squares covering the site, but it tends to occur less frequently than Daubenton's bat. The third *Myotis* species occurring in Ireland are whiskered bats and although there are records from Co. Donegal, it is the rarest of the three species.

10(iii).72 The cottage at T4 was confirmed as a transitional roost for at least three bats and although the emerging bats did not emit any calls, it is considered that they may have been *Myotis* species or alternatively brown long-eared bats as a result of this behaviour, which can be typical of these species on emergence. As detailed in the survey report in Appendix I (see Appendix 9 in Volume 3 of the EIAR), approximately 13 minutes after the last bat emerged, calls from *Myotis* species were detected in the vicinity, which combined with the pre-dusk emergence, pointed to the building being occupied by *Myotis* bats.

4.3.4 Brown long-eared bat

10(iii).73 As shown by Table 6 in Appendix I (see Appendix 9 in Volume 3 of the EIAR), brown long-eared bat activity was low with no activity detected in the north-eastern section of the site (T1, T2, T3) and also at T7. No brown long-eared bats were recorded during the autumn deployment; and during the spring (11 passes) and summer (20 passes) the deployment location, where proposed turbines were subsequently dropped, dominated the registrations, specifically D.10 and D.11 in the southwest section of the study area. Over the summer deployment marginally higher activity levels were also detected adjacent to the middle planation at T4 and west of T6 and T5 on the open hillside (D.04 and D.07).

4.4 Bats associated with proposed turbine locations

10(iii).74 **Table 5** clearly shows that all static detectors recorded low levels of bat activity during the three deployments. Figure 6 in Appendix I (see Appendix 9 in Volume 3 of the EIAR), shows the locations of seasonal deployments in relation to the finalised turbine positions. Based on total bat passes per hour, the data suggests that the southwestern end of the Application Site (T8) may receive marginally higher levels of bat activity. The slightly lower elevation and proximity/connectivity to the Stracashel River valley, which has relatively high suitability for foraging bats in term of habitat features, may contribute to this pattern of site usage.

10(iii).75 Across the middle and north-eastern part of the Application Site, static detectors positioned to cover more open locations, including: D.01 (T2), D.03 (T3), D.07, D.08 (T7), typically recorded slightly lower levels of bat activity than those positioned closer to habitat features (forestry/ woodland edge) including: D.02 (T1), D.04 (T4), D.05 (T5), D.06 (T6). However, given the notably low number of bat registrations it is difficult to discern any significant patterns of usage with certainty, and marginally higher activity by a single bat on one night can skew the data in favour of a particular deployment location. The main point is that usage of the area as a whole was exceptionally low, as would be expected to be the case for upland sites.

Table 5. Summary of activity (bp/h) recorded bystatic detectors in 2019
- colour coded to reflect activity levels (green – *low*, amber – *medium*, red – *high*)

Turb. No.	Map ID	Spring deployment June		Summer deployment August		Autumn deployment Sept-Oct	
		Total Bat Passes	Total bat passes per hour bp/h	Total Bat Passes	Total bat passes perhour bp/h	TotalBat Passes	Total bat passes per hour bp/h
T1	D.02	No deployment	No deployment	No deployment	No deployment	6	0.04
T1/2	D.01	9	0.08	9	0.09	0	0.00
T3	D.03	5	0.05	19	0.18	4	0.03
T4	D.04	9	0.08	33	0.31	7	0.04
T5	D.05	No deployment	No deployment	No deployment	No deployment	17	0.09
T6	D.06	11	0.10	10	0.10	No deployment	No deployment
T6/5	D.07	11	0.10	11	0.10	2	0.01
T7	D.08	0	0.00	8	0.08	0	0.00
T8/7	D.10	28	0.25	22	0.21	No deployment	No deployment
T8	D.09	13	0.37	21	0.20	0	0.00
T9 dropped	D.11	28	0.25	39	0.37	No deployment	No deployment

5 ASSESSMENT OF IMPACTS

5.1 Ecological evaluation of bat species

10(iii).76 Bats are protected by law in the Republic of Ireland under the Wildlife Act 1976 and subsequent amendments (2000 and 2010). Under the Wildlife Act, it is an offence to intentionally disturb, injure or kill a bat or disturb its resting place. Under this legislation it is unlawful to destroy, alter or disturb known bat roosts without an appropriate derogation licence, as issued by the National Parks and Wildlife Service (NPWS).

10(iii).77 All bat species fall under Annex IV of the EU Habitats Directive (1992), whereby member states have a burden of responsibility to protect bats and their resting places wherever they occur. The EU Habitats Directive has been transposed into Irish law with the European Communities (Birds and Natural Habitats) Regulations 2011. In order to comply with the requirements of these regulations wind farm applications in Ireland need to be assessed as to their potential impact on bat populations.

10(iii).78 In order to undertake an assessment of the potential impact of the proposal on bats, it is necessary not only to have carried out surveys to ascertain what bat species and numbers are present on the site, but also how susceptible those species are to impacts from wind turbines and how susceptible populations of the species occurring are to the impacts in an Irish context.

10(iii).79 SNH *et al.* (2019) provides guidelines for conducting risk assessment for bat species occurring on wind farms; however, it is not fully clear how the assessment methodology relates to Irish bat populations. Therefore, the assessment of Graffy Wind Farm draws on several sources to emulate the SNH guidance, including Marnell *et al.* (2009)[14] and Wray *et al.* (2010) for the bat population assessments in Ireland (see **Table 6**). For collision risk of bat species to wind turbines (see **Table 7**) SNH *et al.* (2019) is used, which updates previous species risk assessment published in Natural England (NE, 2014)[15].

10(iii).80 As listed in **Table 6**, on an all-Ireland basis Leisler's bats are considered to be *Near Threatened*, while all other species are categorised as *Least Concern* (Marnell *et al.*, 2009).

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[14] Marnell, F., Kingston, N. & Looney, D. (2009). *Ireland Red List No. 3: Terrestrial Mammals*, National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland

[15] Natural England (2014). *Bats and onshore wind turbines: Interim Guidance* 3rd Ed. Natural England Technical Information Note TIN051, Natural England, Peterborough.

10(iii).81 As shown in **Table 7**, Leisler's bats and Nathusius' pipistrelles are considered as *high risk* of direct impacts from wind turbines, as they regularly fly in the open and at heights, which may put them at risk of collision or barotrauma from turbines. The SNH *et al.* (2019) guidelines consider both common and soprano pipistrelles to be at *high risk* of direct impacts from wind turbines, based on a study investigating bat collisions at wind farm sites across the UK (Mathews *et al*, 2016), which found both these species to be amongst the most commonly recorded casualties during searches of turbines. The SNH *et al.* (2019) guidelines update Natural England guidance, which had classified common and soprano pipistrelle as *medium risk* species (NE, 2014), based on flight behaviours of common and soprano pipistrelles that habitually fly low and close to landscape features, such as hedgerows. *Myotis* species and brown long-eared bats are considered as *low risk* based on behaviour and foraging techniques of these species.

On the basis of information

10(iii).82 **Table 8**, it is clear that particular attention should be paid to Leisler's bats and Nathusius' pipistrelles, which are believed to be susceptible to impacts from wind turbines and have populations of *high population vulnerability*, in the context of wind turbine developments in Ireland. Leisler's bats are generally considered to forage habitually at height in more open landscapes and are less associated with habitat features than other bat species. Nathusius' pipistrelles are known to be migratory and may fly at height during migration. For this assessment we adhere to SNH *et al.* (2019) guidance, under which common and soprano pipistrelles are considered to have *medium population vulnerability* to wind farm developments in Ireland due to behaviour in relation to turbines. Whiskered bats are also classed as *moderately vulnerable*, due to scarcity in Ireland. Brown long-eared bats and the two other Irish *Myotis* species (Daubenton's bat and Natterer's bat) are considered to have *low vulnerability* to wind farm developments in Ireland.

Table 6. Conservation status of bat species in Ireland

Species	Rarity in Ireland Wray *et al*. (2010)[16]	Irish status (Marnell *et al*., 2009)
Daubenton's bat *Myotis daubentonii*	Rarer (Frequent/widespread)	Least concern
Whiskered bat *Myotis mystacinus*	Rarest (Scarce/widespread)	Least concern
Natterer's bat *Myotis nattereri*	Rarer (Scarce/widespread)	Least concern
Leisler's bat *Nyctalus leisleri*	Rarer (Frequent/widespread)	Near threatened
Common pipistrelle *Pipistrellus pipistrellus*	Common (Widespread)	Least concern
Soprano pipistrelle *Pipistrellus pygmaeus*	Common (Widespread)	Least concern
Nathusius' pipistrelle *Pipistrellus nathusii*	Rarer (Rare/restricted)	Least concern
Brown long-eared bat *Plecotus auritus*	Rarer (Frequent/widespread)	Least concern

Table 7. Level of collision risk to individual bats from wind turbines
Sources: Adapted from Natural England (2017) & SNH *et al*. (2019)

Collision risk		
Low risk	**Medium risk**	**High risk**
Myotis species Brown long-eared bat	Common pipistrelle (NE, 2014) Soprano pipistrelle (NE, 2014)	Leisler's bat Nathusius' pipistrelle Common pipistrelle (SNH, 2019) Soprano pipistrelle (SNH, 2019)

Table 8. Level of potential vulnerability of bat populations in Ireland
Sources: Adapted from Wray *et al*. (2010), Natural England (2014) & SNH *et al*. (2019)
Yellow = ***low*** population vulnerability Beige = ***medium*** population vulnerability Red = ***high*** population vulnerability

Ireland		Collision risk		
		Low risk	**Medium risk**	**High risk**
Relative abundance	**Common species**		Common pipistrelle Soprano pipistrelle **(NE, 2014)**	Common pipistrelle Soprano pipistrelle **(SNH *et al*., 2019)**
	Rarer species	Daubenton's bat Natterer's bat Brown long-eared bat		Leisler's bat Nathusius' pipistrelle
	Rarest species	Whiskered bat		

[16] Wray, S., Wells, D., Long, E. & Mitchell-Jones, T. (2010) *Framework for valuing bats in Ecological Impact Assessment*, CIEEM journal. Edition 70. Pg. 23 – 25. December 2010.

5.1.1 Valuing bat populations

10(iii).83 The nature conservation value of a receptor is based upon a geographic hierarchy of importance. The following categories are used to inform the assessment of impacts:

- International: sites, habitats and species populations of international or European importance;
- National: sites, habitats and species populations of national importance;
- Regional: sites, habitats and species populations of importance in a regional (NW) context;
- County: sites, habitats and species populations of importance in a county context;
- Local: sites, habitats and species populations of importance in a parish or district context;
- Low: sites, habitats and species populations of less than local importance but still of some value.

10(iii).84 Approaches to attributing nature conservation value to species have been developed for bats (see Wray *et al*. 2010) [17]. The approach to scoring foraging habitat and commuting features is summarised in **Table 9** below.

10(iii).85 **Table 10** provides a summary of bat population vulnerability to wind farm impacts (see

10(iii).86 **Table 8**), species activity recorded at Graffy (low, medium, high based on Kepel *et al*., 2011 – see results in Table 6 in Appendix I) and the regional importance attached to bat populations found to occur at Graffy (locally to internationally important based on Wray *et al*, 2010 – see **Table 9**).

10(iii).87 Using the criteria set out in **Table 9** and based on the baseline data collected during surveys, it is considered that the Graffy study area scored:

- 5 to 10 for numbers of bats recorded for all species recorded
- 1 to 3 for no to potentially small nearby roosts for all species recorded
- 3 for foraging habitat characteristics for all species recorded

10(iii).88 Which translates to species scores of:

- 11 to 18 for common species, including common and soprano pipistrelles, ranking the Application Site as holding foraging populations of these species that are of ***Local Importance***.
- 14 to 21 for rarer species including Leisler's bat, *Myotis* species (Daubenton's bat and Natterer's bat) and brown long-eared bat, ranking the Application Site as holding foraging populations of these species that are of ***Local Importance*** to ***County Importance***.

[17] Wray, S., Wells, D., Long, E. & Mitchell-Jones, T. (2010) *Framework for valuing bats in Ecological Impact Assessment*. CIEEM journal. Edition 70. Pg. 23 – 25. December 2010.

- 29 to 36 for *Myotis* species (whiskered bat if occurring) ranking the Application Site as holding foraging populations which are of ***County to Regional Importance***.
- **Note**: Whiskered bats are considered to occur locally in small numbers across Ireland and it is acknowledged that it is a species that can go undetected during surveys (McAney, 2006)[18]. They have been recorded in Co. Donegal, with three locations published on NBDC Biodiversity Maps, the closest of which is *c*. 15 km to the north of the Application Site. The species could potentially occur on exposed upland sites like Graffy; however, expected occurrence would be considered unlikely to very infrequent, and as the risk of collision for *Myotis* species is considered low, further consideration is only given to this species within its Genus (i.e. as *Myotis* species).

10(iii).89 The bat species recorded utilising the Application Site are generally considered common and widespread in an Irish context and low levels of bat activity was recorded for all the species detected. However, taking into account the EU Annex IV protected status of bats, the bat assemblage is considered to represent a feature of ***Local (Higher) importance*** for more common species to ***County Importance*** for rarer species.

[18] McAney, K. (2006) A conservation plan for Irish vesper bats. *Irish Wildlife Manuals*, No. 20. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Table 9. Scoring system for valuing sites and foraging areas/ commuting routes for bats

Score	Species	Score	Number of bats	Score	Roosts/ potential roosts nearby	Score	Foraging habitat characteristics / Type and complexity of linear features
2	Common	5	Individual bats	1	None	1	Site without established vegetation e.g. urban
						1	Absence of (other) linear features
				3	Small number	2	Suburban areas or intensive agriculture
						2	Unvegetated fences and large field sizes
5	Rarer	10	Small number	4	Moderate number or not known	3	Isolated woodland, less intensive agriculture etc
						3	Walls, gappy or flailed hedgerows, isolated well grown hedgerows, and moderate field sizes
				5	Large number or close to protected areas for bats	4	Large connected woodland blocks, mixed agriculture etc
						4	Well-grown and well-connected hedgerows, small field sizes)
20	Rarest	20	Large number	20	Close to or within SAC for bats	5	Mosaic of pasture, woodlands and wetlands
						5	Complex network of mature well-established hedgerows, small fields and rivers/streams

Importance	Score
International	> 50
National	41-50
Regional	31-40
County	21-30
Local	11-20
Not important	1-10

Table 10. Summary of bat population vulnerability to wind farm impacts, species activity recorded at Graffy and the regional importance attached to bat populations found to occur at Graffy

Species	Population vulnerability wind farms impacts	Activity levels at Graffy Based on Kepel *et al.* (2011) Range in bp/h is shown for all the static bat detectors deployed	Population Importance at Graffy (Scoring based on Wray *et al.*, 2010)
Leisler's bat	High	Low Not recorded during Autumn 2019 deployment of statics Range of bat passes/ hour 2019: 0.01 to 0.11 Abundance: Small numbers	Local (14 to 21)
Common pipistrelle	Medium	Low Notes: Consistently the most commonly occurring species Range of bat passes/ hour 2019: 0.01 to 0.15 bp/h Abundance: Small numbers	Local (11 to 18)
Soprano pipistrelle	Medium	Low Notes: Sporadic - activity Range of bat passes/ hour 2019: 0.01 to 0.07 bp/h Abundance: Small numbers	Local (11 to 18)
Myotis species	Low	Low Not recorded during Autumn 2019 deployment of statics Range of bat passes/ hour 2019: 0.01 to 0.26 bp/h Abundance: Small numbers	Local (14 to 21)
Brown long-eared bat	Low	Low Notes: Not recorded during Autumn 2019 deployment of statics Range of bat passes/ hour 2019: 0.01 to 0.05 bp/h Abundance: Small numbers	Local (14 to 21)

5.2 Impacts on bats

10(iii).90 Wind turbines and associated infrastructure present a number of potential impacts to bats, namely:

- Damage of / or disturbance to roost sites
- Loss or fragmentation of habitat
- Collision with rotor blades and barotrauma
- Displacement or disturbance of commuting or migration routes

10(iii).91 The first two of these are most relevant to the construction phase of the project, while the latter two relate to potential impacts in the operational phase. The following sections provide an assessment of the potential impacts on bats during two phases of the project, including construction phase impacts and operational phase impacts.

10(iii).92 The results from bat surveys conducted over the 2019 active season found the low levels of activity that would be expected at an upland site such Graffy Hill, with exposed elevation and open expanses dominated by mosaics of tightly grazed blanket bog, wet heath, acid grassland and conifer plantations, with a limited number of habitat features, such as forestry edge and rides, small woods/ shelter belts, derelict cottages, earth banks and upland eroding streams. No hibernation or maternity roosts were identified within the turbine envelope, although a small transitional roost was located in a derelict cottage adjacent to the Application Site near T4 (Structure 1 in Table 5 and Figure 2 in Appendix I (included in Appendix 9 in Volume 3 of the EIAR).Although unconfirmed during the bat activity surveys, this bat roost was considered likely to support a small transitional roost of *Myotis* species (possibly males, as these are known to roost in small numbers together – see Roche *et al*., 2014) given their behaviour on emergence and the recordings obtained nearby within 15 minutes of emergence from this roost. Hibernation roost inspection conducted in Feb-2021 did not confirm roosting bats, however it was not possible to survey some parts of the building and results were considered inconclusive.

10(iii).93 Due to the proximity of the confirmed bat roost cottage to T4, ongoing monitoring will be required to ascertain that occupancy does not exceed that of a small transitional roost. Based on Wray *et al*. (2010), at present it is considered that this roost is of 'County importance' as it supports small numbers of non-breeding rarer bat species.

10(iii).94 Despite low levels of bat activity across the Application Site, it is considered to support a bat a population of ***Local (Higher)*** to ***County Importance*** (also noting the regular occurrence of foraging/ commuting Leisler's bat).

5.3 Construction phase: Potential direct impacts on bats

10(iii).95 Loss of a roost site resulting from demolition or disturbance during construction would be considered as a significant negative impact of a proposed development. Potential direct impacts on bats resulting from wind farm construction include vegetation removal, resulting in a loss of potential roost sites in mature trees or the removal/ modification to existing buildings on the site. The potential for any vegetation/ building removal or modification to impact on roost site for all species recorded along the turbine haul route and the grid connection route also needs to be considered.

10(iii).96 Preliminary roost assessment surveys identified three structures (Structures 1, 6 and 14) with moderate or moderate to high roost potential that were within the 266 m Zone of Influence for proposed turbine locations - T4, T7 and T8, respectively – Figure 2 in Appendix I (included in Appendix 9 in Volume 3 of the EIAR). No maternity roosts were identified during the emergence survey conducted over the 2019 active season. Only one of the structures (Structure 6) was assessed as having moderate to high potential to be utilised as a hibernation roost, which, in line with the guidance outlined in Wray *et al.* 2010, would be considered to be of County Importance, if confirmed to support rarer species of hibernating bats, even in small numbers. Structure 1 was identified as supporting a small transitional roost of *Myotis* species or brown long-eared bats (three unidentified bats) in the autumn and was assessed as having features with low to moderate potential to act as a hibernation roost, with a building inspection during the winter proving inconclusive (in that no hibernating bats were located, but not all parts of the building could be surveyed).

10(iii).97 No demolition or modification of existing buildings has been proposed as part this project. The locations of Structures 6 (a potential hibernacula) and 14 are sufficiently distant from the turbine locations (c. 255 m from T7 and c. 235 m from T8, respectively) and other site infrastructure, so as not to be directly impacted by construction works.

10(iii).98 Structure 1 is a derelict cottage within 95 m of T4 and lies directly adjacent to the Application Site boundary. Construction works, including removal of the trees surrounding the building will result in the modification of roost suitability by limiting connectivity between the roost and the surrounding landscape, potentially resulting in a small number of bats no longer using the site as a transitional roost during the autumn. Therefore, **in the vicinity of T4 construction works, undertaken in the absence of mitigation, have the potential for direct impacts on roosting bats that are considered to be Significant at the County scale, given the rarer bat species that are utilising this roost (*Myotis* species/brown long-eared bat).**

10(iii).99 The removal of vegetation potentially supporting roosts will be required to establish an access track between T4 and T5/T6 and to establish appropriate buffers between the rotor swept area and habitat features utilised by foraging/ commuting bats. This will involve the removal Sitka spruce plantation and some mature sycamore and Sitka spruce trees surrounding Structure 1in the vicinity of T4. All the young trees within the plantations have been assessed as having no PRFs and the mature trees around T4 were assessed as having no to negligible PRFs. Therefore, following assessment of such features, it is considered that **construction works will not directly impact any potential tree roosts**.

10(iii).100 Along the grid connection route, there were four structures assessed as having moderate or moderate to high bat roost potential that were identified as being within a 30 m buffer of the application site, including Structures 9, 14, 16 and 18. Given the limited scope of the works proposed for laying cable (trench excavation and fill along existing roads and forestry tracks), ***no direct impacts to potential bat roosts are anticipated during construction works for installation of the grid connection***.

10(iii).101 Tree felling is required along sections of the haul road to facilitate transportation of turbines onto the site. For these areas Sitka spruce will be removed that was assessed as having no potential roost features for bats. Therefore, ***tree removal along the haul route will have no direct impacts on potential bat roosts***.

5.4 Construction phase: Potential secondary impacts on bats

10(iii).102 Potential secondary impacts on bats resulting from construction works are limited to the loss and fragmentation of foraging and commuting habitats/ features utilised by bats. Disturbance of roosting and foraging bats through lighting impacts was considered; however, there will be no night-time working at the site and it is understood that no additional lighting will be required during the construction phase of the works.

10(iii).103 The development of infrastructure for the turbines and access tracks will mainly result in the loss of small areas of upland blanket bog/ wet heath and acid grassland. These habitats will be permanently lost to hardstands, tracks and turbines; however, the small areas of open habitat that will be lost are not considered to represent any significant loss to foraging bats, particularly since the data shows that foraging activity over the open bog/ heath / grassland was generally very low. Therefore, **in the context of bat foraging habitats, the loss of a small area of open bog heathland/grassland is assessed as being of imperceptible magnitude and low significance**.

10(iii).104 Areas of conifer plantation will be removed to facilitate the construction of the access track between T4 and T5/T6, as well as to implement appropriate buffers between rotor swept areas and features utilised by foraging/ commuting bats. The largest area requiring removal will be around T1 and to create the appropriate stand-off, approximately 2.672 ha of Sitka spruce plantation will be removed. Smaller areas will be removed at T4 (0.33 ha), T5 (0.29 ha) and T6 (0.474 ha)

10(iii).105 The construction of the T4 to T5/T6 access track through the conifer plantation will effectively create a forestry ride increasing edge effects and potentially providing sheltered foraging opportunities for bats. Therefore, **the loss of conifer plantation between (0.22ha) T4 and T5/T6 in the context of bat foraging/ commuting habitat is assessed as having a neutral to slightly positive impact of low significance**.

10(iii).106 Where required the impact of implementing bat buffers around turbines will, in most instances, involve cutting back conifer plantation to the appropriate standoff, which is anticipated to have a neutral impact on foraging/ commuting bats, as any existing edge effect will be replicated post-felling by the residual edge of the plantation that remains unfelled. The exception will be the removal of mature sycamores and Sitka spruce, which form an open woodland around T4 that provides connectivity with the neighbouring plantation. Low usage by all bat species occurring on the site was recorded in this area (a minimum of five species), with some of the activity associated with bats roosting in a derelict cottage (Structure 1). **In the absence of mitigation, tree removal in the vicinity of T4 has the potential for secondary impacts on foraging and commuting bats that are considered to be Significant at the Local to County scale depending on the species present**.

10(iii).107 No vegetation removal is proposed along the grid connection and therefore there will be no secondary impacts to foraging or commuting bats.

10(iii).108 Tree felling is required along sections of the haul road to facilitate transportation of turbines onto the site. For these locations, areas of Sitka spruce within Coillte forestry plantations will be removed. Aside from a line of more mature Sitka spruce trees at one location, the remainder of the trees are relatively young. While no bat activity surveys were undertaken, it is acknowledged that felling operations will create some level of disruption to established bat foraging patterns in the area. However, the overall area of tree removal will be small and the existing edge effects will be replicated post-felling by the residual edge of that plantation that remains unfelled. Therefore, **in the context of bat foraging habitats, the loss of conifer plantation at two locations on the haul route is assessed as being of imperceptible magnitude and low significance**.

5.5 Operational phase: Potential direct impacts on foraging and commuting bats

10(iii).109 Both direct collision with rotor blades and barotrauma (injuries to internal air cavities and blood vessels caused by sudden change in air pressure behind a moving blade), have been found to directly impacts bats (e.g. Cryan & Barclay, 2009,[19] Rydell *et al.*, 2010,[20], Cryan *et al.* 2014,[21] & Mathews *et al.*, 2016[22]). The evaluation of Irish bat species likely to be at risk from collision and barotrauma is detailed in **Table 7** above and is in part related to the likelihood of different species flying at rotor blade height in an open landscape. The SNH *et al.* (2019)[23] guidance incorporates the 50 m set-back distance between the rotor swept area and habitat features (such as forestry edge and treelines/ hedgerows), which was originally published in the Natural England guidance[24]. However, this guidance mainly applies to certain species such as common and soprano pipistrelles, which are known to follow linear habitat features when foraging or commuting. It is not relevant to upland areas where linear features are absent or sites where Leisler's bat activity is high, since this species is just as likely to fly over open terrain as along habitat features.

10(iii).110 Different bat species have different foraging behaviours and ecological requirements and infrastructure such as wind turbines will affect different species in different ways. Each of the bat species recorded at the Application Site are considered in the following sections. It is important to note that the probability of impact is lower for those turbines located away from habitat features. In such open habitat, the probability of such an impact is *Unlikely*, given the low levels of bat activity recorded. However, where turbines are located within close proximity to features such as the edge of conifer plantations, small woods/ shelter belts or derelict buildings, notably at proposed turbine locations for T1, T4, T5 and T6, there is potential for a greater occurrence of bats within the rotor-swept area, resulting in increased potential for impact. Therefore, the potential direct impacts of the proposal on bats are considered, without mitigation, to be ***Significant*** at the ***Local*** scale (given that

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[19] Cryan, P. & Barclay, R (2009). Causes of Bat Fatalities at Wind Turbines: Hypotheses and Predictions. *Journal of Mammalogy* 90, 1330-1340

[20] Rydell, J., L. Bach, M. J. Dubourg-Savage, M. Green, L. Rodrigues & A. Hedenström. (2010). Bat mortality at wind turbines in northwestern Europe. *Acta Chiropterologica* 12:261-274.

[21] Cryan, P. M., P. M. Gorresen, C. D. Hein, M. R. Schirmacher, R. H. Diehl, M. M. Huso, D. T. Hayman, P. D. Fricker, F. J. Bonaccorso & Johnson D. H. (2014). Behavior of bats at wind turbines. *Proceedings of the National Academy of Sciences* 111:15126-15131.

[22] Mathews, F. Richardson, S. Lintott, P. & Hosken, P. (2016). *Understanding the Risk to European Protected Species (bats) at Onshore Wind Turbine Sites to inform Risk Management*. Final Report from University of Exeter University for RenewableUK and the UK Department of Energy & Climate Change (DECC)

[23] Scottish Natural Heritage, Natural England, Natural Resources Wales, Renewable UK, Scottish Power Renewables, Ecotricity Ltd, University of Exeter & Bat Conservation Trust (2019). *Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation*.

[24] Natural England (2014). *Bats and onshore wind turbines: Interim Guidance* 3rd Ed. Natural England Technical Information Note TIN051, Natural England, Peterborough.

common species are more likely to occur within the rotor-swept area, albeit in low numbers).

NOTE: The potential impacts of the wind farm on bat populations in the area need to be considered in the context of proposed mitigation measures. That mitigation will include minimum separation distances from likely (foraging and commuting) features of 50 m to the rotor swept areas for all turbines, necessitating the need for vegetation clearance; and then re-planting appropriate areas to compensate for the habitat loss and ensure integrity of the wider area for foraging and commuting bats.

5.5.1 Operational phase: Potential direct impacts on common and soprano pipistrelles

10(iii).111 As listed in **Table 7**, both common pipistrelles and soprano pipistrelles are considered to be of *high risk* of injury or mortality from wind turbines, resulting from either barotrauma or collision, based on the behaviour and foraging techniques of these species. Both species typically show an affinity to habitat features such as scrub, treelines and hedgerows; however, pipistrelles are also known to forage more regularly in open habitat, such as the open heath that occupies the vast majority of the Application Site. Some of the proposed infrastructure at the site is close to features that are used by these species for foraging/ commuting. A study (Mathews *et al*., 2016) monitoring bat fatalities at wind farms around the UK found that these two species of pipistrelle were amongst the casualties most commonly recorded during turbine searches.

10(iii).112 As summarised in **Table 10**, common and soprano pipistrelles are widespread and common in Ireland; however due to flight behaviour, population vulnerability to windfarm developments for both species is classed as *Medium*.

10(iii).113 At the Application Site activity levels for common and soprano pipistrelles across all the deployment locations and seasons were *low*. However, the proposed locations of four turbines (T1, T4, T5 and T6) in close proximity to forestry and woodland will result in rotor swept areas being within metres of the forestry/ woodland edge under certain wind directions, which increases the collision risk for these species.

10(iii).114 Without mitigation, potential impacts of the operational phase on common pipistrelles and soprano pipistrelles are considered to be ***Significant*** at the ***Local*** level.

5.5.2 Operational phase: Potential direct impacts on Leisler's bats

10(iii).115 As listed in **Table 7**, Leisler's bats are considered to be at *high risk* of injury or mortality from wind turbines, resulting from either barotrauma or collision, based on species behaviour and foraging techniques. Leisler's bats are strong and fast in flight, regularly foraging over, or taking direct flights across, open habitats at heights within the collision risk zone for turbines. A study (Mathews *et al*., 2016) monitoring bat fatalities at wind farms around the UK found that common noctule bats (*Nyctalus noctula*), were amongst the casualties most commonly recorded during turbine searches (along with common and soprano pipistrelles). Common noctule bats are not known to occur in Ireland; however, it is a similar species to Leisler's bats (lesser noctule bats) in terms of flight behaviour and therefore similar levels of collision-risk would be predicated. Leisler's bats are very sparsely distributed in England and Wales and only occasionally recorded in Scotland. This explains why it was not encountered during turbine searches based in the UK.

10(iii).116 As summarised in **Table 10**, population vulnerability to windfarm developments is classed as *High*, given the importance of Ireland as a global stronghold for Leisler's bat.

10(iii).117 At the Application Site, activity levels for Leisler's bat across all the deployment locations and seasons was *low*. Levels of Leisler's bat activity were suggestive of commuting bats and occasional (sporadic) bouts of intensive feeding by a number of bats (probably individuals or small numbers) that then move onto different areas, which would be considered typical behaviour for this species at upland sites like Graffy.

10(iii).118 The proximity of T1, T4, T5 and T6 to forestry/ woodland, is likely to increase the collision risk for Leisler's bat, although this effect is likely to be less pronounced than for common or soprano pipistrelles, which are reported to exhibit stronger associations with habitat features. The risk level of potential direct impact for this species is also likely to vary seasonally depending on prevailing weather conditions.

10(iii).119 Without mitigation, potential impacts of the operational phase upon Leisler's bat are considered to be ***Significant*** at the ***Local*** level.

5.5.3 Operational phase: Potential direct impacts on *Myotis* bat species

10(iii).120 As listed in **Table 7**, *Myotis* bats are considered as being at *low risk* of impact from wind turbines, based on species behaviour and foraging techniques. A study (Mathews *et al*., 2016) monitoring bat fatalities at wind farms around the UK found a single carcass of a *Myotis* bat during the searches (a Natterer's bat - *Myotis nattereri*). *Myotis* species in the UK are rarely recorded flights at heights above the canopy (20 to 30 m) and tend to prefer a more cluttered habitat due to their short range and high frequency echolocation characteristics. Furthermore, their relatively slow flight speed allows them to manoeuvre well and therefore have the agility to avoid collision events (Mathews *et al*., 2016 & Rydell *et al*., 2010). Because of the behaviour exhibited by these species, the probability of direct operational impact is *Unlikely*.

10(iii).121 As summarised in **Table 10**, population vulnerability to windfarm developments for all three *Myotis* species regularly occurring in Ireland is classed as *Low*

10(iii).122 At the Application Site activity levels for *Myotis* species across all the deployment locations and seasons were *low*.

10(iii).123 Without mitigation, potential impacts of the operational phase on *Myotis* species are considered to be ***Not Significant***.

5.5.4 Operational phase: Potential direct impacts on brown long-eared bats

10(iii).124 As listed in **Table 7**, brown long-eared bats are considered as being at *low risk* of impact from wind turbines, based on species behaviour and foraging techniques. A study (Mathews *et al*., 2016) monitoring bat fatalities at wind farms around the UK found a single brown long-eared bat carcass during the searches. Typically, this species flies at low height and close to vegetation. Because of the behaviour exhibited by this species, the probability of such an impact is *Unlikely*.

10(iii).125 As summarised in **Table 10**, population vulnerability to windfarm developments for brown long-eared bats is classed as *Low*.

10(iii).126 At the Application Site activity levels for brown long-eared bats across all the deployment locations and seasons was *low*, although it is acknowledged that this species are more difficult to detect using bat detectors alone – visual observations during bat transect surveys were also carried out. Interestingly, minor hotspots of activity at more open locations in the southwest of the study area were detected for this species and were thought to be brown long-eared bats commuting along a steep stream valley leading up onto the west facing slopes of Graffy Hill. The turbine initially proposed for this general location was subsequently dropped for the final site layout. This action, aimed to ensure that this apparently well-used commuting route (albeit for relatively low numbers of this rarer species) was preserved within the design of this proposal.

10(iii).127 Even without further mitigation, potential impacts of the operational phase on brown long-eared bats are considered to be ***Not Significant***.

5.6 Operational phase: Potential secondary impacts

10(iii).128 There is not considered to be any potential for secondary impacts on bats during the operational phase. The potential for secondary impacts on bats during the operational phase is considered to be limited due to the low levels of site usage recorded. The exception is the potential for displacement of bats (suspected to be *Myotis* species) utilising Structure 1 - the cottage adjacent T4. Tree felling required to implement 50m standoffs between the rotor swept area and the features may alter the suitability of this structure, which has been identified as supporting a transitional bat roost (suspected of being *Myotis* species). **Therefore, in the absence of mitigation, the operational site has the potential for secondary impacts on roosting bats that are considered to be Significant at the County scale given the rarer bat species that are utilising this roost (*Myotis* species/brown long-eared bat).**

6 RECOMMENDATIONS AND MITIGATION

10(iii).129 The potential significant effects of the proposed wind farm development on bats have been assessed and in the absence of mitigation the following potential significant effects were identified:

- During the construction phase the potential for direct impacts on bats roosting in a cottage near T4 was considered *Significant* at the *County* scale given the rarer species utilising this roost (in line with guidance outlined in Valuing Bats in Ecological Impact Assessment – see Wray *et al.*, 2010).
- During the construction phase the potential for secondary impacts on foraging/ commuting bats from tree removal in the vicinity of T4 was considered *Significant* at the *Local* to *County* scale depending the species classification (common or rarer).
- During the operational phase the potential for direct impacts on foraging/ commuting bats from collision or barotrauma due to the location of wind turbines (specifically T1, T4, T5, T6) was considered to be *Significant* at the *Local* scale for common pipistrelles, soprano pipistrelles and Leisler's bats and not significant for other less-susceptible species recorded foraging and commuting on this site i.e. *Myotis* species and brown long-eared bats.
- During the operational phase the potential for secondary impacts on roosting bats at the T4 cottage – Structure 1 was considered to be *Significant* at the *County* scale, as a small transitional *Myotis* roost, with the possibility of supporting a hibernation roost.

10(iii).130 Mitigation measures have been identified and are discussed for the following potential significant effects:

- Avoidance of potential direct impacts to a bat roost
- Avoidance of potential secondary impacts on bat foraging/ commuting habitat
- Avoidance of wind turbine collision or barotrauma events

10(iii).131 This section also outlines the options for the provision of compensatory habitat and any requirements for post-construction monitoring.

6.1 Mitigation to avoid potential direct impacts to a bat roost during construction

10(iii).132 A derelict cottage adjacent to the Application Site near T4 (Structure 1- Figure 2 in Appendix I (included in Appendix 9 in Volume 3 of the EIAR) was assessed as having moderate potential as a maternity roost, with low-moderate potential as a hibernation roost -Table 5 in Appendix I (included in Appendix 9 in Volume 3 of the EIAR).

10(iii).133 Emergence surveys conducted at the cottage did not identify any maternity roosts, but a small transitional roost (supporting three unidentified bats) was detected. Given their behaviour on emergence from the roost (e.g. flight pattern, lack of echolocation and later emergence from the roost), and the detection of *Myotis* species nearby within approximately 15 minutes of emergence, it is considered that these bats are *Myotis* species (a rarer species in the North West of Ireland, based on Wray *et al.*, 2010). The building inspection undertaken during the hibernation (winter) period was inconclusive, in that no bats were recorded, but not all parts of the cottages could be fully surveyed. Therefore, although no bats were found in the features accessed, this building is still considered as having the potential to sustain a low number of hibernating bats in some of the crevices that could not be examined. While there are no plans to alter the existing structure, construction works in the vicinity, including tree removal to implement bat buffer zones around T4 (see below), have the potential to directly impact the suitability of the building should any roosting bats be present.

10(iii).134 The cottage is located within *c.* 95 m of T4, which places it within or very close to the minimum 50 m separation distance between blade tips and bat features. To reduce the risk of bat-turbine interactions, removal of the structure was considered. However, as baseline surveys indicated limited usage by low collision risk species, retention of the building and enhancement of the surrounding habitat was considered the more appropriate option. While only a relative low level roosting activity was identified during the baseline study, further pre-construction surveys will be required to monitor occupancy, as there is a risk that this building could become more heavily occupied in the seasons prior to construction. Ongoing monitoring will inform the requirement for further measures to preserve and possibly enhance this building, or alternative buildings. This information will also inform the application of a derogation license from NPWS to undertake appropriate mitigation action to ensure the conservation of bats using this roost, as required.

10(iii).135 The preferred option is the retention of the building and the implementation of a 30 m exclusion zone during the construction phase, to prevent disturbance during times of occupancy. Periods of occupancy will be confirmed following pre-construction surveys and the baseline indicates usage is limited to the autumn. **Table 11** provides restrictive periods for different types of roosts, during which the 30 m exclusion zone for construction work would be applicable.

10(iii).136 Alternatively, measures to make the building unsuitable for roosting bats may be required, if the proximity to T4 presents a significant collision risk, i.e. if the roost is found to be occupied by higher collision risk species, namely Leisler's bats, common pipistrelles and/or soprano pipistrelles. While this was not the case during baseline surveys, the low levels of activity will be confirmed by pre-construction surveys. Making the building unsuitable for roosting bats will require the provision of alternative compensatory roosting structures. Depending on the size and type of roost being excluded there is an appropriate scale of options available ranging from provision of bat boxes to the selection of other abandoned cottages in the vicinity that can be retrofitted to create suitable bats roosts.

Other structures in the vicinity of the Application Site have been identified during roost assessment surveys (see Table 5 in Appendix I, included in Appendix 9 in Volume 3 of the EIAR)

10(iii).137 No other bat roosts were identified within the turbine envelope, and any features assessed as having moderate or moderate to high bat roost potential were judged to be sufficiently removed from the Zone of Influence, so as not to be directly impacted during the construction phase of the project.

Table 11. Optimal season for works at different roost types
Source: Kelleher & Marnell (2006)[25]

Bat usage of site	Optimum period for carrying out works (some variation between species)
Maternity	01-Oct to 01-May
Summer (not a proven maternity site)	01-Sep to 01-May
Hibernation	01-May to 01-Oct
Mating/swarming	01-Nov to 01-Aug

6.2 Mitigation to avoid potential secondary impacts on bat foraging/ commuting habitat during construction

10(iii).138 The only location where removal of vegetation was judged to potentially impact on foraging/ commuting bats was in the vicinity of T4. Construction of the access track between T3 and T4, as well as implementation of a *c.* 100 m turbine buffer zone for bats, will result in the removal of a small open woodland consisting of mature Sitka spruce and sycamores that provides connectivity to a nearby forestry plantation via treelines and scattered mature trees. In addition, bat usage may be linked to a derelict cottage in the area that offers moderate to high roost potential. The maximum size of the area over which tree/scrub removal will occur equates to *c.* 0.16 ha.

10(iii).139 To replace the loss of bat commuting/foraging habitat adjacent to T4, there will be an equivalent area identified as compensatory habitat. The approach for replacement of habitat features is outlined in Figure 22 in Appendix I (included in Appendix 9 in Volume 3 of the EIAR).

10(iii).140 The re-planting will aim to maximise future woodland, hedgerow and treeline ecological function by specifying an appropriate species mix and replacement locations to maximise connectivity. In the latter case, full consideration must be taken of bat usage of the site. It is recommended that replanting aims to strengthen connectivity from the cottage to the

[25] Kelleher, C. & Marnell, F. (2006) Bat Mitigation Guidelines for Ireland. *Irish Wildlife Manuals*, No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland

plantation to the north, as shown in Figure 22 in Appendix I (included in Appendix 9 in Volume 3 of the EIAR).

10(iii).141 A low treeline/hedge (< 3m) will also be planted to replace trees along the western and southern edges of the cottage and although, this would fall on the edge of the turbine buffer for bats, planting is considered necessary to retain the integrity of the roost. Once this hedgerow/treeline has become established the taller trees around the cottage can be felled to limit the height of the bat features.

10(iii).142 For the creation of bat buffers zones around other turbines, including T1, T5, and T6 the full extent of foraging features for bats, specifically forestry edge will not be impacted at locations where felling of conifer plantation is required. Any existing edge effect will be replicated post-felling by the residual edge of the plantation that remains unfelled. Generally, there is a requirement that all commercially forested areas which are removed must be replaced. This is not site specific and the loss can be offset at any location across the country.

6.3 Mitigation to avoid collision or barotrauma

10(iii).143 The main mitigation measure here is avoidance. This relates to the design of the wind farm infrastructure to implement a minimum of 50 m separation distance from habitat features used by bats and the tips of turbine blades, as recommended by the Natural England (2014)[26] guidelines, which have been adopted by SNH *et al.* (2019)[27]. The worst-case scenario for the specification of the turbines proposed for Graffy Wind Farm, with hub height of 84 m) results in a blade sweep that will be 18 m from the ground. As illustrated in **Figure 1** (included in Appendix 9 in Volume 3 of the EIAR) and **Table 12** below, depending on feature height the buffers from turbine tower to features (bat buffer zone) required for Graffy WF ranges from 83m for features at 3m, to 103m for features at 30m, in order to achieve the minimum standoffs of 50 m. Buffers must be calculated using the final height that features are predicted to reach during the operational lifespan of the wind farm, e.g. a young plantation may reach heights of 25 m prior to harvesting, with tree heights rarely exceeding 30 m in upland areas like Graffy.

10(iii).144 As shown in Figure 17 in Appendix I (included in Appendix 9 in Volume 3 of the EIAR), four turbines have been positioned to comfortably exceed the 103 m turbine-feature buffer, including T2, T3, T7 and T8. Due to other design constraints, the four other

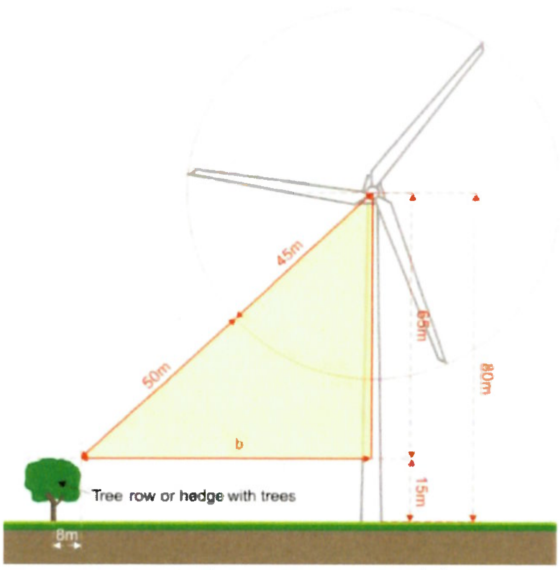
[26] Natural England (2014). *Bats and onshore wind turbines: Interim Guidance* 3rd Ed. Natural England Technical Information Note TIN051, Natural England, Peterborough
[27] Scottish Natural Heritage, Natural England, Natural Resources Wales, Renewable UK, Scottish Power Renewables, Ecotricity Ltd, University of Exeter & Bat Conservation Trust (2019). *Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation.*

turbines could not be located in positions to achieve the minimum 50 m separation distance and without mitigation will impinge on commercial forestry plantation at T1, T5 and T6, with T4 being adjacent to a small open woodland surrounding a derelict cottage.

10(iii).145 To achieve the minimum 50 m separation distances at T4, where there are some tall mature trees (max. feature heights = 30m) a max. 103 m tower to feature buffer will be required – Figure 21 in Appendix I (included in Appendix 9 in Volume 3 of the EIAR)

10(iii).146 To achieve the minimum 50 m separation distances at T1, T5 and T6 (max. feature heights = 20m) a 97 m tower to feature buffer will be required –Figures 18, 19, 20 in Appendix I (included in Appendix 9 in Volume 3 of the EIAR)

10(iii).147 The area where trees/ scrub is cleared to create the turbine buffers for foraging/ commuting bats must be rendered as unsuitable as possible, and maintained as such over the lifetime of the wind farm. Felled timber and branches must be removed, with stumps brashed to ground level. Any excess spoil from excavation works during construction can be broadcast to cover over any ground stumps to create a more homogeneous surface. To prevent the area scrubbing up, a mowing or grazing regime will be implemented. Monitoring will be required post-construction to ensure compliance.



Where bl = blade length, hh = hub height, fh = feature height (all in metres)

$$b = \sqrt{(50 + bl)2 - (hh - fh)2}$$

Figure 1. Equation to calculate tower buffers to maintain 50 m standoffs blade tip to habitat feature

Table 12. Turbine buffers for bat features

Feature height	Turbine-feature buffer
30 m feature	103 m
25 m feature	100 m
20 m feature	97 m
10 m feature	89 m
5 m feature	85 m
3 m feature	83 m

6.4 Post-construction monitoring

10(iii).148 Based on SNH *et al.* (2019) guidelines, post-construction monitoring for wind turbines would only be required at developments where the mitigation involves turbine curtailment. With mitigation in place, through the creation of appropriate turbine to features buffers, the proposed Graffy Wind Farm has been assessed as posing a low risk to bat populations utilising the area in the vicinity of the application site. Curtailment is not recommended as a mitigation measure at Graffy WF and therefore no post-construction monitoring at turbines is required.

10(iii).149 Depending on the decisions relating to Structure 1, (the derelict cottage near T4) there will be a requirement to monitor roost occupancy at the building post-construction and/ or monitor compensatory alternative roosts created in the area.

10(iii).150 In addition, given that habitat removal is required at four turbines (T1, T4, T5, T6) it is recommended monitoring for sapling re-establishment, scrub control and grazing regime at this site in undertaken for a minimum of 3 years during year 2 post-construction, year 5 post-construction and year 7 post-construction. This should also include an agreement on required grazing regimes with the relevant landowner which should be taken forward as intrinsic to the development should this planning application be successful.

7 CONCLUSIONS

10(iii).151 An impact assessment for bat population utilising the proposed site for Graffy Wind Farm was conducted and, in the absence of mitigation, found there is potential for significant effects on the following features that are considered to be of Local (Higher Value) to County Importance:

- Roosting bats at Structure 1 (derelict cottage near T4)
- Bat foraging/ commuting habitat (for creation the bat buffer zone around turbines T4),
- Collison or barotrauma common and soprano pipistrelle bats and Leisler's bat.

10(iii).152 Mitigation measures have been proposed, including:

- The development of a protection plan for the transitional bat roost identified at Structure 1 adjacent to T4. This will be informed by on ongoing pre-construction monitoring of this cottage and as minimum will include a construction zone buffer of 30m during the autumn (September to October inclusive), when baseline surveys have confirmed occupancy.
- Compensatory habitat (*c.* 0.16 ha) for foraging/ commuting bats to replace vegetation removal at T4 – as outlined in Figure 22 in Appendix I (included in Appendix 9 in Volume 3 of the EIAR). This will include planting of a low treeline/hedge around the cottage.

- Creation of bat buffer zones around turbines to maintain a minimum separation distance of 50 m between blade tip and feature. This will be applicable to T1, T4, T5 and T6 – Figure 18 to Figure 21 in Appendix I (included in Appendix 9 in Volume 3 of the EIAR)

10(iii).153 It is considered that the proposed measures, if implemented as recommended and in full, will mitigate entirely for any potential impacts on foraging, commuting or roosting bats at the proposed wind farm on Graffy Hill, and will result in an overall residual impact on bats that utilise the Application Site of ***negligible significance***.

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10(iv) FISHERIES & AQUATIC ECOLOGY

This chapter 10(iv) addresses the assessment of impacts on aquatic ecology by the proposed Graffy wind farm. The wider biodiversity chapter contains information on different specialist subject areas of ecology, and has been presented in five different sections, written by a number of experts and has been broken down into the following sub-sections:

(I) flora & fauna

(II) avi-fauna

(III) bats

(IV) aquatic ecology

(V) freshwater pearl mussel

Appendix 1 and Figures 1, 4, 5, 6, 7, 8 and 11 in the assessment are contained in Appendix 10 of Volume 3: Appendices in the EIAR

Contents

10.1.1 Description of Development

The proposed Graffy Wind Farm is located in an area that drains to two separate river catchments; the Stracashel River sub-catchment of the Owenea River, which flows to the west), the Stranagoppoge River sub-catchment of the River Finn, which flows to the east (Figure1).

The proposed development will comprise eight wind turbines and a 7.5km connection cable from a proposed substation at Meenagrubby to the existing Tievebrack substation at Drumnalough. Infrastructure within the wind farm landholdings will include construction of new floating and excavated access tracks, a temporary contractors' compound area, a substation, on site drainage management works, spoil disposal areas, underground electrical cables, junctions and turning areas, turbine bases, foundations, turbine hardstands and temporary set-down areas and a meteorological mast. The cable connecting the proposed wind farm to the Tievebrack station will be installed directly within the existing road infrastructure and will cross above or below watercourse culverts/ bridges. In addition, several areas of the development will involve upgrading of the transport route via widening and the creation of a new short access road through existing Coilte land.

10.1.2 Statement of Authority

Paul Johnston Associates Ltd is an independent fisheries consultancy specialising in freshwater fisheries and water resource management in Ireland; a range of specialist services is provided in relation to fish stock assessment, water quality status, environmental impact assessment and fisheries management. As co-Director, David Kelly holds a BSc (Hons) in Zoology and a PhD in Environmental and Fisheries Ecology; he is also a Member of the Institute of Fisheries Management (MIFM) and a registered member of the Chartered Institute of Ecology and Environmental Management (CIEEM).

The practice has completed a wide range of assignments in the areas of environmental impact assessment, fisheries development and catchment management. This experience includes fisheries and aquatic ecological assessments in connection with a series of land-based wind farm developments in Northern Ireland and the Republic of Ireland.

10.1.3 Scope and Purpose

This chapter assesses the effects of the proposed wind farm on fish stocks and habitats in the stream network both within the site boundary and in downstream watercourses directly connected to the site.

Impacts on aquatic ecology and fisheries may be caused by:

- Loss of fish through pollution from the site during the construction phase;
- Loss of fish and aquatic flora and fauna or damage to aquatic habitats through run-off of suspended solids due to site construction works;
- Reduced productivity due to obstruction of fish passage or loss of habitat in watercourses.

The fisheries and aquatic ecology assessment involved desktop review of relevant information/data, field surveys, data processing, analysis and interpretation. Current fisheries data and relevant conservation information on local rivers is assimilated and supplemented through site specific fisheries and ecological surveys of the proposed development covering the principal watercourses within and downstream of the planning application boundary.

Field survey procedures consisted of walkover surveys of the principal watercourses, assessments of physical habitat conditions, measurement of basic chemistry parameters, collection of benthic invertebrate samples for assessment of biological quality, and a fish stock survey by electrofishing.

The principal consultees during the study were Inland Fisheries Ireland and the Loughs Agency, who were consulted with regard to the scope of the assessment and to provide data on fish stocks in relevant watercourses. IFI commented by email on May 22nd 2019 as follow" We *wish to advise that our correspondence to the planning authority on the original application 09/30520 and to An Bord Pleanala PL 05 B.237656 should be noted. Notwithstanding this, the proposed development will of course be examined in detail and our response will be based on the application as presented*". In the original submission by the northern Regional Fisheries Board (NRFB, now part of IFI), the fisheries sensitivity of the site within the Stracashel and Owenea Rivers was noted with an emphasis on mitigations of sediment and peat slippage, the importance of the Owenea River in maintaining populations of endangered Freshwater Pearl Mussel (FPM) also was highlighted, together with the importance that juvenile salmonids play in the life-cycle of the mussels. The potential impact of sediment on FPM was highlighted.

IFI emphasised that the following measures should be included within a CMS;

- Piling should be used at turbine locations with deep peat.
- All turbine bases must provide a 50m-buffer to the nearest watercourse, unless otherwise confirmed.
- A permeable staked silt curtain must be provided on all stilling ponds.
- Design detail of water crossings must be notified to IFI in advance.
- Water quality monitoring should include an automated alarm for suspended solids concentration. These alarms should be installed on a number of water courses draining the site. Warning events should be notified to IFI and the Council as they occur.
- Excavated soil / peat should be reseeded immediately.
- The works method statement shall be forwarded to the IFI.
- Stilling ponds should be sized.

10.1.4 Description of the Study Area

The study area focused on the watercourses draining the proposed site / planning application boundary, which are small tributaries of either the Stracashel River (Owenea) or Stranagoppoge River (Finn). Field survey work was carried out on these streams both within the planning application boundary and in potentially sensitive downstream reaches including the main Stracashel and Stranagoppoge rivers.

10.2 Administration, Policy and Guidelines

10.2.1 Fisheries Administration

Governance and administration of fisheries within the general area is the responsibility of one of two government agencies dependant on the geographic location of specific river catchments draining the respective zones of the proposed site. The wind farm development footprint within the west/ south-western zone draining to the Stracashel (Owenea) is located within the area controlled by Inland Fisheries Ireland (IFI), the state agency responsible for the protection, management and conservation of inland fisheries. The north-eastern area of the windfarm development footprint drains into Lough Foyle via the Stranagoppoge (Finn) and falls within the cross-border Loughs Agency's area of responsibility.

IFI was established in 2010 following the amalgamation of the Central Fisheries Board and the seven former Regional Fisheries Boards into a single agency. The principal function of IFI is the protection, management and conservation of the inland fisheries resource. The general functions are to promote, support, facilitate and advise the Minister on the conservation, protection, management, marketing, development and improvement of inland fisheries, including sea angling.

The cross-border Loughs Agency is an agency of the Foyle, Carlingford and Irish Lights Commission (FCILC), established under the 1998 Agreement between the Government of the United Kingdom of Great Britain and Northern Ireland and the Government of Ireland.

Under Section 11 (6) of the Foyle Fisheries Act (Northern Ireland) 1952 and the Foyle Fisheries Act 1952 (Republic of Ireland) the Foyle Fisheries Commission was given the responsibility for "the conservation, protection and improvement of the Fisheries of the Foyle Area generally". Under the North/South Co-Operation (Implementation Bodies) (Northern Ireland) Order 1999, and the British Irish Agreement Act 1999 these functions were extended to include the Carlingford Area, and the Foyle Fisheries Commission transferred its functions to the Loughs Agency.

10.2.2 Policy

Specific policy relevant to fisheries and aquatic biodiversity in this region includes:

- National Biodiversity Plan (2011)
- UK Biodiversity Action Plan (2007)
- River Foyle & Tributaries Area of Special Scientific Interest
- River Finn Special Area of Conservation (SAC)
- West of Ardara/ Maas Road SAC
- Atlantic Salmon Management Strategy for Northern Ireland and the Cross-Border Foyle and Carlingford catchments to meet the objectives of NASCO resolutions and agreements, 2008–2012 (DCAL).

- North Western International River Basin District Eel Management Plan (Inland Fisheries Ireland/Loughs Agency/DAERA).

10.2.3 Guidance

Specific guidance documents relevant to the Proposal include:

- Standing Scientific Committee on Salmon (2017). The Status of Irish Salmon Stocks in 2016 with Precautionary Catch Advice for 2017. Independent Scientific Report to Inland Fisheries Ireland.
- Standing Scientific Committee – Advice on DAERA Area Salmon Stocks 2019.
- CIEEM Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal (2018).
- Environmental Protection Agency (2003) Advice Notes on Current Practice in the preparation of Environmental Impact Statements;
- Environmental Protection Agency (2017) Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports;
- Wind Farm Development Guidelines for Planning Authorities (2006);
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- Eastern Regional Fisheries Board (not dated) Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites;
- Guidelines on Protection of Fisheries during Construction works in and adjacent to waters (Inland Fisheries Ireland 2016).
- Guidelines for Fisheries Protection during Development Works (Foyle and Carlingford areas); Environmental Guidelines Series – No. 1 (Loughs Agency).
- Guidelines for the crossing of watercourses during the construction of national road schemes (National Roads Authority).
- Culvert Design and Operation Guide (C689) (CIRIA, 2010)

10.3 Assessment Methodology

10.3.1 Desk Study

A desk study was carried out to determine baseline information relating to fisheries and water quality (biotic and abiotic). The following sources were consulted/used:

- Inland Fisheries Ireland
- Loughs Agency
- Environmental Protection Agency - Water Quality Reports and Water Framework Directive (WFD) status
  http.//www.epa.ie/pubs/reports/water/waterqua/

10.3.2 Field Study: Stream Quality

Fields surveys to determine baseline ecology and water quality of streams within and downstream of the main development site where the turbines and access routes are planned were conducted in November 2020 by sampling the benthic macroinvertebrate community and taking spot water samples.

Aquatic Ecology

Stream benthic community analysis provides a broad indication of sensitivity to a range of environmental stressors, including fine sediment; these communities have taxa with relatively long lifespans and restricted mobility that allows for the integration of stressor effects over longer timescales than may be indicated by physico-chemical parameters alone (Matthaei et al. 2006; Extence et al. 2013).

During November 2020, ten streams draining the development site were sampled for benthic macroinvertebrates using a standard three minute kick sample (hand held 1mm mesh net) followed by a one minute search; this method is recommended by the United Kingdom Technical Advisory Group (UK-TAG) for assessing the condition of the quality element "benthic invertebrates" for WFD reporting (WFD-UKTAG, 2014) and, together with information on aquatic macrophytes and phytobenthos, also informs the determination of the Irish EPA Quality rating system (Q-values) for monitoring biological water quality in streams (Toner et al. 2005). Sampling was conducted in locations at the downstream extent of the site boundary where possible but upstream of any roads to exclude potentially confounding effects of road and traffic on stream ecology. The percent river bed cover of macrophytes, periphyton and presence of sewage fungus also was noted. Where possible, samples were collected from riffle/run habitats, fixed in 4% formalin for 1 week, followed by preservation in 70% ethanol prior to sorting and identification.

Basic water quality was measured at each site using portable meters to provide an outline profile of chemical quality with a focus on dissolved oxygen and electrical conductivity; the latter parameters were measured because of their importance in identifying generally suitable conditions for fish and invertebrates while conductivity also provides an indication of the presence of other potential pollutants such as raised nitrate and phosphate. Dissolved oxygen was measured using a Hanna Oxy-Check oxygen meter, and conductivity with a Hanna HI86303 conductivity meter; temperature measurements also were made with the pH meter.

In the laboratory, macroinvertebrate samples were spread across a 4 x 5 20-square grid sorting tray to facilitate identification and to estimate relative abundance. Abundant taxa were counted in a subset of 5 squares and scaled to estimate whole sample abundance as recommended in Murray-Bligh (2002). Less abundant taxa were counted in all grid squares. For each site, EPA Q-values were determined as per the methodology described in Toner et al. (2005); invertebrate taxa are allocated to one of five indicator groups that represent a range of sensitivities to organic pollution and additional qualifying criteria such as sewage fungus and phytobenthos growth that determine final Q-value assignment. Intermediate Q-values denote transitional conditions and there is a generalised relationship between Q-value scores, invertebrate community diversity and water quality classes (Table 10.1). Invertebrate community baseline also was summarised using total number of taxa, total site BMWP-WHPT score, and average score per taxon (ASPT), based on the abundance weighted sensitivity scores developed by Walley and Hawkes (1997) as recommended for the Water Framework Directive (WFD-UKTAG, 2014).

Table 10.1 Generalised relationship between Q-values, community diversity and water quality (adapted from Toner et al. 2005).

Quality Value	Diversity	Quality Class	Quality Status
Q5, 4-5, 4	HIGH	A	Unpolluted
Q3-4	REDUCED	B	Slightly polluted
Q3, 2-3	LOW	C	Moderately polluted
Q2, 1-2, 1	VERY LOW	D	Seriously polluted

Physical Habitat

Physical stream characteristics (substratum type, depth, flow velocity) were measured using the fully quantitative method developed by DAERA IFD and AFBI. In each site, surveys consisted of a 40m stream reach with 25 sampling points across five equidistant cross-sectional transects except on very narrow (<0.3m width) and overgrown streams where it was difficult to observe the riverbed; on these streams, up to 12 transects (1-3 sampling points per transect) were surveyed in each reach; estimates of siltation also facilitated the assignment of Q-values.

At each sampling point, flow velocity was recorded at 60% depth using a Geopacks flow meter, with water depth measured using the meter's impeller stick; substrate was visually assessed using a bathyscope with the dominant substrate type recorded according to a modified Wentworth Scale (Bain et al. 1985; Table 10.2).

Table 10.2 Substrate classification and scoring based on the Wentworth system (from Bain et al. 1985).

Substrate type	Size Class (mm)	Score
Sand/silt	<2	1
Gravel	2-16	2
Pebble	17-64	3
Cobble	65-256	4
Boulder	>256	5
Irregular Bedrock	na	6

The following physical characteristics also were measured:

- Stream width at each transect
- Percentage of deposited fine sediment (<2mm grain) on the river bed as per Clapcott et al. (2011), with the dominant fine sediment type (sand, silt, clays) determined by running the grain through the observer's fingers

The classification system of Bain et al (1985) was used to summarise the composition of substrate in a reach based on two indices:

- Coarseness index (CI) – calculated as the mean dominant substrate score
- Heterogeneity (SD) – calculated as the standard deviation of the mean CI.

These indices show how coarse or smooth the substrate of a reach is and if it is comprised of a mixture or is dominated by a particular substrate class (Table 10.3).

Table 10.3 Substrate description inferred from sample data (modified from Bain *et al.* 1985).

Mean substrate score (CI)	Heterogeneity (SD)	Inferred substrate description
3.2	1.96	Heterogeneous, smooth and rough
5.0	0.00	Homogeneous, coarse
1.25	0.44	Nearly homogeneous, smooth
3.25	0.85	Heterogeneous, intermediate coarseness
5.05	0.69	Heterogeneous, coarse

10.3.3 Field Study: Fisheries Habitat

An outline assessment of the streams draining the proposed development site was carried out in September 2020 and consisted of walkover surveys recording general characteristics to provide an outline assessment for these watercourses. This was then complimented through a fish stock survey by electrofishing.

The grid connection cable will remain largely within the existing public road infrastructure and forestry tracks and will be installed by cutting and filling of an open trench. At watercourse crossings along the road, cutting and filling will occur where there is sufficient headroom above existing culverts (see Cable Installation, Section 10.6.4). However, where there is insufficient headroom, the cable will be deployed by coming "off-line" so that installation proceeds by either damming and diversion of water around the works or via trenchless means beneath the watercourse using Horizontal Direct Drilling, thus reducing the potential for direct interaction with watercourses. Therefore, walkover surveys also were conducted in January 2021 to record salmonid habitat characteristics of streams intersecting the proposed cable connection route. Similarly, walkover surveys recording salmonid habitat quality also were conducted of the small watercourses that intersect and drain the areas where upgrading of roads and creation of the new access road is proposed.

The descriptive terminology used in the survey is based on the Life Cycle Unit method (Kennedy, 1984) currently used by the Loughs Agency and DAERA Inland Fisheries in Northern Ireland (see also DANI advisory leaflet No 1). In summary, habitat type is recorded as:

- Nursery (shallow rock/cobble riffle areas for juvenile fish - fry/parr)
- Holding (deeper pools/runs for adult fish)
- Spawning (shallow gravel areas for fish spawning)
- Unclassified (unsuitable for fish – shallow bedrock areas or heavily modified sections of channel)

10.3.4 Field Study: Juvenile Fish Stocks

Monitoring of fish stocks by IFI and the Loughs Agency tends not to include sampling sites in the upper reaches of tributaries in most river systems. Therefore, this part of the fisheries assessment considered the principal streams draining the development site and set out to obtain details on salmonid distribution in areas of the headwater reaches of local rivers not covered in routine sampling by IFI and the Loughs Agency.

A juvenile fish stock survey of the streams draining the main development site and downstream river reaches was carried out by electrofishing at selected locations in September 2019 by PJA Ltd. Additional fish surveys were conducted in May/ June 2021 at watercourses along the cable route where habitat assessment indicated potential to support salmonid fish.

Electrofishing was carried out according to a semi-quantitative methodology described by Crozier and Kennedy (1994). The procedure involves two operators fishing continuously in an upstream direction for five minutes at each sampling location, using an E-Fish 500W single anode electrofishing backpack (EF-500B-SYS). The system operates on 24V input and delivers a pulsed DC output of 10 to 500W at a variable frequency of 10 to 100Hz. Output voltage and frequency are adjusted according to the electrical conductivity measured at the survey site.

All fish were caught using a dip net and retained for general inspection and length measurement before being returned to the water live. Any additional Age 0 salmonids observed but not captured were also recorded. This method is consistent with IFI and Loughs Agency monitoring procedures.

The semi-quantitative electrofishing method has been calibrated separately for trout and salmon based on extensive studies in river reaches of known juvenile salmonid density. This has resulted in the development of an abundance classification system (Abundance Index) for salmon with five categories: Absent, Poor, Fair, Good, Excellent (Table 10.4a). The Abundance Index for trout has six classifications: *Absent, Poor, Poor/Fair, Moderate, Good, Excellent* (Table 10.4b).

Table 10.4 Semi-quantitative abundance categories for age 0 salmon (a) and trout (b), as developed by Crozier and Kennedy (1994) Kennedy (*unpublished data*).

(a) Salmon:

Fry (0+) nos.	Density (No/100m^2)	Abundance/ quality category
0	0	Absent
1 – 4	0.1 – 41.0	Poor
5 – 14	41.1 – 69.0	Fair
15 – 24	69.1 – 114.6	Good
25+	114.6+	Excellent

(b) Trout:

Fry (0+) nos.	Density (No/100m^2)	Abundance/ quality category
0	0	Absent
0 – 1	0.1 – 7.0	Poor
2 – 3	7.1 - 16.5	Fair
4 – 8	17 - 31	Moderate
9 – 17	32 - 59.9	Good
18+	60+	Excellent

10.4 Assessment of Potential Effects

Potential effects were assessed for construction, operational and decommissioning phases of the development.

Effects are described in accordance with the definitions provided in the Glossary of Impacts contained in the guidance documents produced by the Environmental Protection Agency (EPA) and CIEEM (2018):

- Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (EPA, 2003)
- Guidelines on the Information to be contained in Environmental Impact Assessment Reports – Draft August 2017 (EPA 2017)
- CIEEM Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal (2018).

The glossary of impacts as published in the EPA guidance documents is summarised in Table 10.5.

Table 10.5: Impact Classification Terminology (EPA, 2017)

Impact Characteristic	Qualification	Description
Quality	Positive	A change which improves the quality of the environment
	Neutral	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error
	Negative	A change which reduces the quality of the environment
Significance	Imperceptible	An effect capable of measurement but without significant consequences
	Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
	Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
	Moderate	An impact that alters the character of the environment in a manner consistent with existing and emerging trends
	Significant	An effect that alters the character of the environment in a manner consistent with existing and emerging baseline trends

	Very significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment
	Profound	An impact which obliterates sensitive characteristics
Extent & Context	Extent	Describe the size of the area, number of sites and the proportion of a population affected by an effect
	Context	Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions
Probability	Likely	Effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented
	Unlikely	Effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented
Duration & Frequency	Momentary	Effects lasting from seconds to minutes
	Brief	Effects lasting less than a day
	Temporary	Effects lasting less than a year
	Short-term	Effects lasting one to seven years
	Medium-term	Effects lasting seven to fifteen years
	Long-term	Effects lasting fifteen to sixty years
	Permanent	Effect lasting over sixty years
	Reversible	Effects that can be undone, for example through remediation or restoration
	Frequency	Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually)
Type	Indirect	Impacts on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway
	Cumulative	The addition of many minor or significant effects, including effects of other projects, to create larger, more significant effects.

'Do Nothing'	The environment as it would be in the future should the subject project not be carried out
Worst Case'	The effects arising from a project in the case where mitigation measures substantially fail
Indeterminable	When the full consequences of a change in the environment cannot be described
Irreversible	When the character, distinctiveness, diversity, or reproductive capacity of an environment is permanently lost
Residual	Degree of environmental change that will occur after the proposed mitigation measures have taken effect
Synergistic	Where the resultant effect is of greater significance than the sum of its constituents

10.4.1 Fisheries and Aquatic Ecological Sensitivity Criteria

In determining the significance of impacts (imperceptible to profound; Table 10.5), it is essential to consider the sensitivity of the receptor (EPA, 2017). Using the information assembled through the baseline assessment, sensitivity was graded according to generic methods outlined by CIEEM (2018) and the Design Manual for Roads and Bridges (DMRB), specifically with regard to Road Drainage and the Water Environment, Volume 11, Section 3, Part 10 LA 113 (DMRB, 2019). These methods are based on;

- the level of legal protection afforded (e.g. EC site/ species designation vs nationally protected),
- fish species presence (e.g. salmon, trout or other),
- The condition of the physical habitat for the broader aquatic community and salmonid species (e.g. unclassified vs good quality nursery/ spawning; degree of siltation),
- Additional ecological quality information (e.g. Q-value/ ecological condition).

This approach is in line with EIAR requirements that require the description of effects on particular species and habitats protected under the EC Birds (2009/147/EC) and EC Habitats

Directive (92/43/ EEC); effects on land, soil, water, air and climate; the interaction between these factors (EPA, 2017).

The framework in Table 10.6 below provides a broad overview of the approach.

Table 10.6: Estimating the sensitivity/ importance of receptors

Sensitivity	Criteria	Typical Examples
Very High	Attribute has a high quality and rarity on a regional or national scale	WFD Class 'High'. Q-value 5 Site protected/designated under EC habitat legislation (e.g. SAC/ SPA) Species protected by EC legislation (e.g. Atlantic salmon, FPM). Watercourse containing salmon and supporting a nationally important fishery or river ecosystem.
High	Attribute has a high quality and rarity on a local scale	WFD Class 'Good'. Q-value 4, 4-5 Species protected under Irish legislation. Watercourse containing salmon or trout and supporting a locally important fishery or river ecosystem.
Medium	Attribute has medium quality and rarity on a local scale	WFD Class 'Moderate'. Q-value 3, 3-4 Watercourse containing trout and upstream of locally important fishery or river ecosystem.

Sensitivity	Criteria	Typical Examples
Low	Attribute has low quality and rarity on a local scale	WFD Class 'Poor'. Q-value 2, 2-3, Watercourse without salmon or trout but upstream of locally important fishery or river ecosystem.
Negligible	Attribute has very low quality and rarity on a local scale	WFD Class 'Poor'/unspecified. Q-value 1, 1-2 Unclassified salmonid habitat

10.5 Baseline Conditions

10.5.1 Local waters

Stracashel and Owenea Rivers

A number of small tributary streams of the Stracashel River drain the west-south-west portion of the proposed Graffy Wind Farm. The Stracashel River is the main tributary of the Owenea River, draining west for approximately 17km before meeting the Owenea south-west of Glenties (Figure 1). The Owenea River lies parallel and south of the Stracashel where it drains west of Lough Ea for over 20km before entering Loughros More Bay near Ardara.

Stranagoppoge and Finn Rivers

Several small tributaries of the Stranagoppoge River drain the east-north-east portion of the proposed wind farm site. The main Stranagoppoge River flows for approximately 8km before meeting the main River Finn approximately 4km downstream of Lough Finn (Figure 1). The Finn flows for over 50km before entering Lough Foyle at Lifford.

10.5.2 Designated sites

While there are no designations in the immediate wind farm development site relating to the aquatic environment with determinations relating to aquatic habitats or species, a number of designated sites, hydrologically linked to the proposed development through connecting watercourses, are present, while the extreme east and west sides of the development intersect SACs.

River Finn SAC

The southern boundary of the site development and associated drainage streams are located immediately above the upstream boundary of the River Finn SAC (IE002301) on the Stranagoppoge River: the eastern end where upgrading of the road for transport is proposed, intersects the Upper Stranagoppoge River SAC, while a number of small undesignated watercourses drain to the SAC (Figure 1). The designated site extends downstream to the River Finn confluence and along its entire length to Lough Foyle; the following aspects are relevant to fisheries and aquatic habitats;

- The River Finn is designated an SAC in the Republic of Ireland, with Atlantic salmon (*Salmo salar*) and European Otter (*Lutra lutra*) noted as Annex II species selected as the primary reason for the designation of the site.

The SAC comprises almost the entire freshwater element of the River Finn and its main tributaries but also the headwaters of the River Derg in Co Donegal, including the Mourne Beg tributary.

West of Ardara/ Maas Road SAC

A portion of the boundary of the West of Ardara/ Maas Road SAC (IE000197) extends upstream along the Stracashel River, between 2 and 3 km downstream of the small watercourses draining the south-western portion of the immediate wind turbine boundary (Figure 1). However, the area beneath and immediately downstream of the proposed HC cable crossing of the Stracashel is within the SAC where the following aspects are relevant to fisheries and aquatic habitats;

- The SAC is designated in the Republic of Ireland, with Atlantic salmon, Freshwater Pearl Mussel (FPM), European Otter, Atlantic salmon, noted as Annex II species selected as the primary reason for the designation of the site and occurring within the Stracashel and Owenea rivers.
- Oligotrophic water containing few minerals, estuaries, and tidal mudflats and sand flats also are Annex I habitats that have been selected as primary features of the designation.

Foyle and Tributaries SAC/ ASSI

Although the site is located 50km upstream of the River Foyle and Tributaries SAC and ASSI, the lower River Finn is bisected by the international border and several kilometres of the Finn are within the SAC/ASSI in Northern Ireland. The following aspects of the SAC/ ASSI are relevant to fisheries and aquatic ecology;

- River Foyle and Tributaries SAC – The river habitat is a key selection feature with a global assessment grade of "B" International Importance, due to the presence of dynamic flow habitat types, largely natural channel and substrates, and extensive beds of water crowfoot *Ranunculus* in stretches including the Strule. Annexe II listed Atlantic salmon is as a primary selection feature of the designation with a global assessment grade of "B" – International Importance (NIEA, 2015). Annex II listed European Otter, *Lutra lutra*, is also a qualifying feature with a global assessment grade of "C" – National Interest, but is not the primary reason for the designation. Sea Lamprey, River Lamprey, Brook Lamprey and Pearl Mussel are included as selection features of interest (global assessment grade D) but are not qualifying features for the designation (NIEA, 2015).
- River Foyle and Tributaries Area of Special Scientific Interest (ASSI) – The River Foyle and Tributaries was designated as an ASSI in 2003 under Article 28 of the Environment (Northern Ireland) Order 2002, with the designated area corresponding to that of the SAC. The ASSI designation is largely on account of the rivers naturalness of channel and bank, and because of the presence of Atlantic salmon (see below) and European otter.

10.5.3 EU Water Framework Directive

The EU Water Framework Directive (2000), implemented in the Republic of Ireland through the European Communities (Water Policy) Regulations, 2003, requires member states to ensure that all waterbodies attain good ecological status, or where good status is already achieved, prevent any deterioration in state. To achieve the ecological objectives of the Water Framework Directive, River Basin Management Plans have been implemented through Water Management Units (WMUs) during the 2010 to 2015 cycle and continue to be applied through the second cycle, 2015-21. This area is covered by the Lough Foyle WMU and the Owenea/ Owentocker WMU, each of which assess the status of constituent water bodies together with pressures/risks, and proposes an Action Plan to ensure that each of these waters achieves its objectives in terms of ecological status.

As previously noted, the proposed Graffy Wind Farm area includes watercourses that occur in two separate river catchments – the Owenea (Stracashel) and the Finn (Stranagopoge). The WFD waterbodies hydrologically connected to watercourses within the study area are listed in Table 10.7, in the context of the relevant WFD River Sub-basin, WFD Sub-catchment and WFD Catchment, also noting the ecological status for each waterbody as determined for the reporting period 2013-2018. All of these waterbodies are located within the North Western International River Basin District, an area which incorporates all of Co Donegal along with areas of the Foyle, Erne and Melvin catchments extending into counties Derry, Tyrone, Fermanagh, Leitrim, Monaghan, Cavan, Longford and Sligo.

For the Stranagoppoge River Waterbody, the latest WFD status was assessed at Moderate due mainly to the assessment based on the "fish" indicator element. The main pressures affecting water quality status include forestry and clear-felling and chemical pollution from herbicide. In the River Finn, the latest WFD status has been assessed as Moderate to Poor, with river waterbody status generally lower in those waterbodies of the Finn that are located further downstream. Urban wastewater discharges, hydrological impacts due to drainage and overgrazing, and chemical pollution from sheep dip are indicated as key pressures in this catchment.

For the Stracashel, the latest WFD status assessment for both constituent waterbodies (010 and 020) was Good. In the Owenea River immediately downstream of the Stracashel River confluence, the latest WFD assessment was Good status. The current status assessment is reflected in a recent EPA report of pressures and risks where both rivers and associated waterbodies were assessed as "not at risk" of failing to meet WFD objectives (EPA, 2018).

Table 10.7: WFD ecological status of waterbodies within and hydrologically connected to the proposed site (based on EPA data).

WFD Catchment (ID)	WFD Sub-Catchment (ID)	WFD River Sub-Basin	WFD River Waterbody	WFD Status 2013-2018
	Finn_SC_010	STRANAGOPPOGE_010	NW_01S020200	Moderate

Lough Foyle (01)	(01_8)	FINN_020 (immediately d/s of Stranagoppoge)	NW_01F010350	Moderate
		FINN_030	NW_01F010400	Poor
		FINN_040	NW_01F010500	Moderate
		FINN_050	NW_01F010600	Poor
		FINN_060	NW_01F010800	Poor
		FINN_080	NW_01F011100	Poor
Gweebarra-Sheephaven (38)	Owenea_SC_010 (38_9)	Stracashel_010	NW_38S010045	Good
		Stracashel_020	NW_38S010045	Good
		Owenea_030 (immediately d/s of Stracashel)	NW_38O040450	Good

10.5.4 River Biological Quality

The EPA Quality Rating (Q-value) System has been used to monitor the water quality of streams and rivers in Ireland since the 1970s as the key feature of the National River Monitoring Programme. The National Rivers Monitoring Programme was replaced by the Water Framework Monitoring Programme in December 2006.

Under the WFD one of the key elements for assessing river condition is the diversity and number of pollution tolerant macroinvertebrate taxa present, which continue to be monitored and assessed using the Q value system method. All major rivers and their more important tributaries are surveyed and assessed at least every third year for WFD monitoring and reporting purposes.

The most recent results for waterbodies draining the site are presented in Table 10.8. In 2018, both the Stracashel and the Owenea Rivers were assessed as having highly diverse macroinvertebrate communities' indicative of generally unpolluted conditions. In 2016, the benthic invertebrate community of the Stranagoppoge River was assessed as having reduced diversity in the waterbody section immediately downstream of the site drainage streams although this would equate only to slight organic pollution load or low levels of nutrient enrichment. Further downstream, the Stranagoppoge and main River Finn below its confluence were assessed as having highly diverse communities' indicative of unpolluted conditions; it should be noted however that the latest assessment for the Finn below the Stranagoppoge confluence was for 2012.

Table 10.8: The most recent Q-values for key EPA monitoring sites proximate to watercourses draining the proposed development.

WFD River Sub-Basin	WFD River Waterbody	Q-value	Year of assessment	Community diversity	Interpretation
STRANAGOPPOGE_010	NW_01S020100	3-4	2016	Reduced	Slight pollution
STRANAGOPPOGE_010	NW_01S020200	4	2016	Good	Unpolluted
FINN_020 (immediately d/s of Stranagoppoge)	NW_01F010350	4-5	2012	High	Unpolluted
Stracashel_010	NW_38S010045	4	2018	Good	Unpolluted
Stracashel_020	NW_38S010045	4	2018	Good	Unpolluted
Owenea_030 (immediately d/s of Stracashel)	NW_38O040450	4	2018	Good	Unpolluted

10.5.5 Significant Freshwater Species

This section outlines the current status of Annex II freshwater species and other species of conservation interest.

Atlantic Salmon

The Atlantic salmon (*Salmo salar*) is listed in Annex II of the EU Habitats Directive as a species of European importance. The species is featured in Ireland's National Biodiversity Plan (2011) which includes a series of actions aimed at restoration of stocks. In the UK, it was added to the UK Biodiversity Action Plan (BAP) list in 2007 as a priority species for conservation action. More recently the salmon achieved an IUCN threat status of Vulnerable in the Irish Red List No 5 (King *et al*, 2011).

Lamprey

There are three species of lamprey in Ireland:

- Brook lamprey (*Lampetra planeri*)
- River lamprey (*Lampetra fluviatilis*)
- Sea lamprey (*Petromyzon marinus*)

Sea and River lampreys are parasitic and migrate between the freshwater and marine environments, returning to freshwater to breed; in contrast, Brook lamprey are freshwater resident throughout their life cycle and are non-parasitic. All three species are designated under Annex II of the EU Habitats Directive (Directive 92/43/EEC) and present within the Foyle catchment. Within the River Finn SAC, lamprey species are not listed as a selection feature of the designation. The distribution of lamprey species in the Stracashel/ Owenea Rivers is unknown.

The Loughs Agency carried out baseline surveys of juvenile lamprey within the Foyle and Tributaries SAC area in 2012 (Niven and McCauley 2013). Sea lamprey ammocoetes were found only at four sites, all in the River Mourne downstream of migratory barriers, whereas River/ Brook lamprey were more widely distributed. In the Finn catchment, surveys conducted by the Loughs Agency in 2010 found lamprey ammocoetes (species unknown) in only one of twenty-four widely dispersed survey sites; lamprey were present in the middle reaches of the main River Finn but absent at a single survey site on the Stranagoppoge (Loughs Agency, 2011a).

European Eel

The European eel (*Anguilla anguilla*) is not listed under Annex II but has recently been added to the International Union for Conservation of Nature (IUCN) Red List of Threatened Species in the category of Critically Endangered (King *et al*, 2011).

The species is not listed in the EC Habitats Directive but the stock has been in rapid decline throughout its range since around 1980. This has led to the passing of the European Eel Regulation (EC) 1100/2007 which aims to establish measures for the recovery of the stock through action by Member States to implement Eel Management Plans in each eel river basin, in this case the North Western International River Basin District.

There is limited data available on the distribution of eel in the local rivers. Fish stock surveys conducted by IFI on the Owenea River in 2018 reported the presence of eel in unspecified locations (IFI 2018 CWEF surveys, data provided by IFI). Loughs Agency catchment status reports indicate that eels are widely distributed in the River Foyle catchment although the population in the Foyle estuary declined to 3.38% of historical levels between 1967 and 2013 (Barry et al. 2015).

Freshwater Pearl Mussel

The Freshwater pearl mussel (FPM) is listed as a globally endangered species by the IUCN (IUCN, 1996), has protection status provided under Appendix II of the Bern Convention, and is listed under Annex II and V of the EU Habitats Directive (92/43/EEC). FPM also are protected under The Wildlife Act, 1976 and Wildlife (Amendment) Act, 2000.
FPM are distributed in the main Owenea River system and are a key site feature of the West of Ardara/ Maas Road SAC designation. In a 2009 survey of the potential effects of a proposed wind farm on the FPM population of the Owenea River, Moorkens (2009) reported an absence of mussels in the Stracashel River and associated tributaries, but reported mussels in the main Owenea River downstream. A series of surveys from 1988 to 2007 have shown a continual decline in Owenea FPM populations leading to a status assessment of "Unfavourable"; loss of habitat, siltation, and nutrient enrichment were cited as key causes of the mussel populations poor status. As a result of the current status of FPM, and in line with RBMPs, the Owenea River Sub-Basin Management Plan was published to provide a programme of measures to assist in the attainment of "Favourable" conservation status for the FPM population.

Although FPM are cited as present in the River Finn catchment from historical records, an extensive survey by Beasley and Roberts (1999) did not find any despite the sites having similar physico-chemistry and habitat suitability as rivers in which the species was present. In 2009, Moorkens (2009) surveyed the Stranagoppoge River tributary of the Finn for FPM and did not report any presence at sites downstream of where the current development is proposed.

10.5.6 Salmon stock management

Salmon stocks in Ireland are now managed on an individual river basis with the objective that each river must exceed its Conservation Limit for there to be any permitted exploitation of fish either by nets or rods. The conservation limit for Atlantic salmon is defined by NASCO as:

the spawning stock level that produces long term average maximum sustainable yield as derived from the adult to adult stock and recruitment relationship.

In simpler terms the Conservation Limit (CL) for a river is the number of spawning salmon required to ensure that salmon are reproducing in sufficient quantities to produce the next generation of fish.

The procedure for defining CLs is described in some detail in the Report of the Scientific Sub-Committee (TEGOS, 2019). In essence, this involves the extrapolation of established stock and recruitment parameters from 13 monitored rivers in the North-east Atlantic area to Irish rivers using a Bayesian hierarchical stock and recruitment analysis (BHSRA) model. The model generates a CL based on the size of the river (wetted area) and its latitude, which is taken as the mid-point of the catchment area.

10.5.7 Existing data on fish stocks

Adult Salmon Runs and Conservation Limits

Annual monitoring of salmon stocks in the Foyle system is conducted by the Loughs Agency, based on:

- Adult salmon runs;
- Salmon spawning;
- Juvenile fish stocks.

Within the Foyle system, seven fish counters record the upstream and downstream movement of adult fish. Of particular interest to the current study is the adult salmon count data derived from the counter located on the River Finn at Killygordon. The Loughs Agency operates a "real-time" management regime for the Foyle system which aims to manage salmon fisheries and spawning populations in a sustainable manner. Management targets and spawning targets are determined for each river catchment with egg deposition levels set according to the area and quality grading of each section of nursery habitat. A proportion is deducted from the management target allowing for losses through angling, poaching and predation; the remaining figure is referred to as the conservation limit/spawning target.

Adult count data for the Finn was provided by the Loughs Agency. A management target of 5410 adult Atlantic salmon has been set for the Finn Catchment; this equates to a conservation limit/spawning target of 4328 adult fish (Niven and Clarkin, 2018).

The number of adult fish returning to the River Finn each year since 2009 is shown in Figure 2 along with the conservation limit (CL) and management target (MT). In the last 11 years to

2019, the River Finn salmon run has failed to meet the CL or MT and the stock status is unsatisfactory.

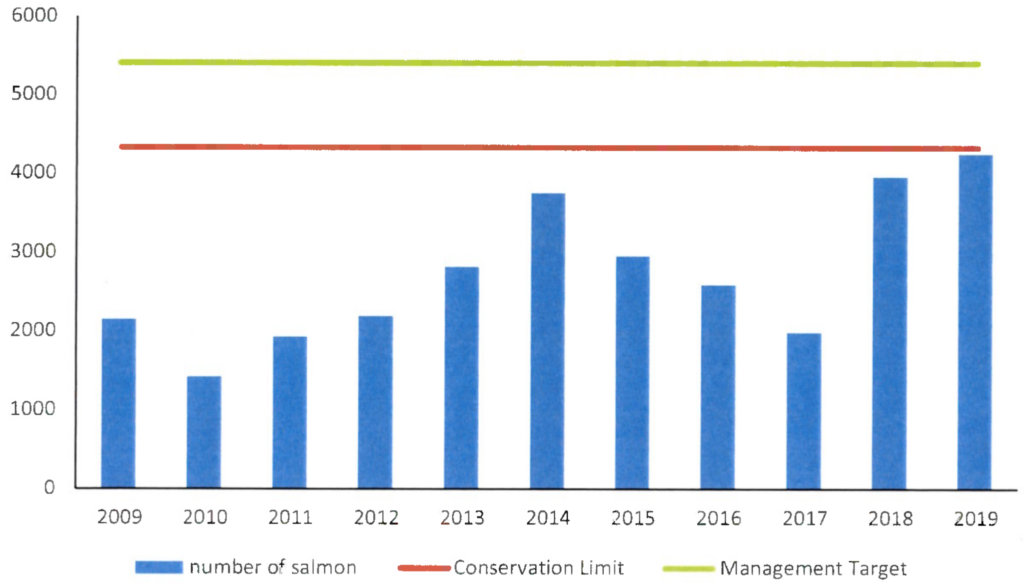

Figure 2: Numbers of salmon ascending River Finn fish counter, 2009-19 (Source: Loughs Agency). N.B. data for 2019 cover the period to Dec. 1st 2019 only.

No fish counter is present on the Owenea River. The conservation limit for the Owenea and Owentocker combined is 1690 salmon. Data on rod catches, estuary draft net catch (assuming specific exploitation rates) and juvenile stock surveys is used to estimate if a river is exceeding (in surplus) its CL. Data of the predicted number of salmon as compared to CL was collated from reports compiled by the Technical Expert Group on Salmon (TEGOS) and from an information request submitted to IFI. The predicted number of adult salmon returning to the Owenea/ Owentocker each year since 2014 is shown in Figure 3 along with the CL. In the last 6 years to 2019, the Owenea River salmon met its CL; however, the surplus in 2018 and 2019 was not considered sufficient in excess of the CL and this resulted in mandatory catch and release for rod anglers.

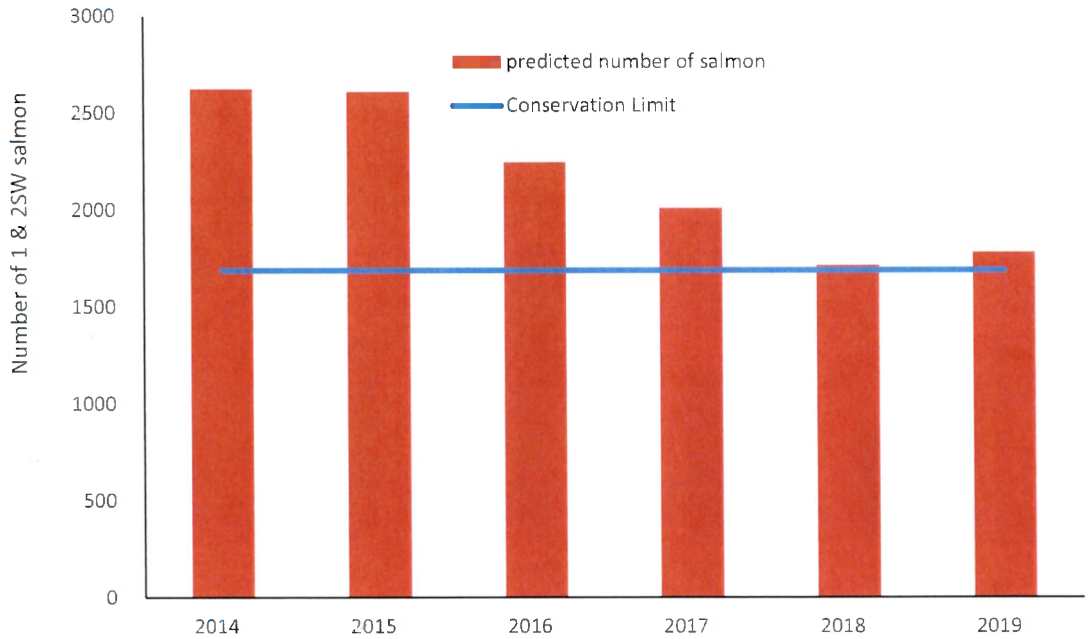

Figure 3: Predicted numbers of salmon returning to the Owena/ Owentocker, 2014-19.

Juvenile salmonid stock status

The distribution and abundance of salmon and trout indicates the level and distribution of spawning by adult fish. Trends in abundance are monitored by IFI and the Loughs Agency in their respective jurisdictions based on standard 5-minute semi-quantitative electrofishing surveys according to the methodology and classification system described previously.

Figure 4 shows the distribution of juvenile salmon from surveys conducted by IFI and the Loughs Agency; IFI surveys of the Owenea and Stracashel Rivers were conducted in 2018 while Loughs Agency surveys of the Stranagoppoge River were conducted in 2016 and 2018. The data demonstrate that salmon spawning is extensive in both the main Stracashel and Stranagoppoge Rivers, with Good to Excellent juvenile abundance; in particular, salmon occurred at Good abundance immediately downstream of tributaries draining the eastern portion of the main wind farm development to the Upper Stranagoppoge and at Excellent abundance at the intersection of the development boundary in the east. Salmon also occurred at Excellent abundance within 1km upstream and 2km downstream of the proposed grid connection cable crossing location of the Stracashel. In 2018 juvenile surveys of 33 Irish catchments, the Owenea produced the highest average number of salmon fry per 5-minutes per electrofishing per site surveyed at 33.94 salmon (TEGOS, 2019).

Figure 5 shows the distribution of juvenile trout in the same surveys conducted by IFI and the Loughs Agency. Trout are less abundant than salmon but are widely distributed within both sub-catchments, occurring at Fair to Good abundance in the main Stracashel and Stranagoppoge Rivers; trout occurred at Moderate abundance immediately downstream of tributaries draining the eastern portion of the main wind turbine development area to the Upper Stranagoppoge.

10.5.8 Angling

The River Finn was one of the most prolific salmon and sea trout rivers in Ireland with grilse runs starting in June and peaking towards the end of July. The main spring fish run is in March and April with the season commencing on March 1st. Fishing rights in the River Finn just below the confluence of the Stranagoppoge, and including the Reelan tributary, are jointly owned by Glenmore Rivers Estate and Cloghan Estate. A number of angling clubs own or lease fishing rights along the remainder of the river including Glebe Anglers, Finn Angling Club, and Ballybofey & Stranorlar Angling Association. The River Finn has consistently failed to exceed the management target of 5,410 returning adult salmon during each of the previous 5 years from 2007; therefore, as per Article 3 of the Foyle Area (Control of Fishing) Regulations 2010, salmon angling on the River Finn has been declared mandatory catch and release, while netting in the Foyle has been suspended.

The Owenea River has historically been a very prolific salmon and sea trout river with most of the fishing based on spate conditions. The river is renowned for its spring and grilse salmon fishing as well as having a good stock of brown trout. Salmon angling in the river is catch and release (2018-2020) owing to a very low surplus predicted number of fish. Fishing is arranged in a series of 9 beats on the lower 8 miles of the main river that are administered by Inland Fisheries Ireland with fishing commencing 1st April to September 30th.

Angling statistics

Details of angling activity and catches of salmon and sea trout (where available) are shown in Table 10.9. These returns are based on incomplete licence/ logbook returns; for the Finn data, a raising factor has been applied in line with Loughs Agency percent licence/ logbook returns and methodology which is based on an analysis by Small (1991). Adjustment of the catch returns for 2016-2018 would suggest average annual catches of 647 salmon (all catch and release) for the River Finn, indicative of a productive fishery despite stock that's is below management targets. In the Owenea, average unadjusted rod catch is 327, which again is indicative of a productive fishery despite more recent declines in the number of returning adult fish. A proportion of returning fish were taken in draft nets but due to suspension in 2018, no further draft netting has occurred. Estimated sea trout catches in the Owenea indicate that despite evidence of a productive fishery, estimated numbers taken in 2017 and 2019 were very low.

Table 10.9: Salmon catches for the Owenea and Finn, 2015-2019 (Source: IFI and Loughs Agency)

Catch statistics	2015	2016	2017	2018	2019	Average
Finn						
Reported salmon rod catch	Not available	211	209	205	Not available	
% licence/ logbook returns	n/a	15	11	12	n/a	
Raising factor	n/a	2.7	3.43	3.2	n/a	
Adjusted salmon rod catch	n/a	570	716	656	n/a	647
Owenea						
Reported salmon rod catch	301	319	465	418	130	327
Reported salmon draft net catch	241	266	143	0 suspended	0 suspended	216 (2015-2017)
Estimated sea trout rod catch	350	250	45	140	30	163

10.5.9 Site Survey: Main Wind Farm development area

Fish Habitat

As outlined previously, the proposed wind farm development is located within land that drains to two different river catchments - the Stracashel (Owenea) flowing to the west, and the Stranagoppoge (Finn) flowing to the east. More specifically, the source of the Stranagoppoge River, including several small 1st Order tributaries drain the north-eastern area of the site; these tributaries have been referred to as follows together with the rationale for survey selection (see also Figure 6);

- Tributary 1 – potential to intercept drainage from Turbine 1 and site infrastructure;
- Tributary 2 – main stem below a series of small streams (including Tributary 3) that drain the area near Turbines 2 and 3, and associated tracks;
- Tributary 3 – potential to intercept drainage from site infrastructure and crossed by new proposed access track to Turbine 2;
- Tributary 4 – potential to intercept drainage from Turbine 3 and site infrastructure, and crossed by new proposed access track to Turbine 3.

Four small 1st and 2nd Order tributaries drain the middle and south-western area of the site to the Stracashel sub-catchment and have been referred to as follows together with the rational for survey selection (Figure 6);

- Tributary 5 – potential to intercept drainage from site infrastructure and crossed by a proposed new access track south-west of Turbine 4.
- Tributary 6 – potential to intercept drainage from site infrastructure and crossed by a proposed new access track between Turbines 4 and 5.
- Tributary 7 – potential to intercept drainage from site infrastructure and crossed by a proposed new access track east of Turbine 5.
- Tributary 8 – potential to intercept drainage from site infrastructure and crossed by two proposed new access tracks – one in it supper reaches for access to Turbine 6, and one in its lower reaches for access track to Turbine 5.

- Tributary 9 – potential to intercept drainage from site infrastructure and crossed by a proposed new access track between Turbine 5 and 7.

The following paragraphs outline details of fisheries habitat within the streams where there is the potential for interaction with the proposed turbine locations and site tracks.

Upper Stranagoppoge River

The main channel of the Stranagoppoge River drains the eastern portion of the site via a number of small tributaries before crossing the L2033 road to continue through rough pasture, bog and coniferous forest plantation (Figure 6). The main channel was surveyed at approximately 1.8km and 2.8km downstream of the site boundary. Habitat in the upper section (1.8km from the site boundary at 192529E 398244N) was largely 2.5-3.0 wide, with eroding bends, relatively deep grade 1 and 2 pools and a peat/ clay base with little substrate complexity to support good nursery and spawning habitat (Plate 1). Habitat quality improved further downstream approximately 2.8km from the site boundary (Impact site 1; Figure 6) with mainly grade 1 and 2 nursery habitat in riffles and runs with smaller areas of grade 3 spawning and deeper grade 1 and 2 pools below a series of cascades passable to adult salmonids (Plates 2 - 4).

Plate 1: Stranagoppoge River 1.8km d/s site boundary

Plate 2: Stranagoppoge River at impact site 1 showing grade 2 nursery

Plate 3: Stranagoppoge River 2.8km d/s site boundary: grade 1 & 2 nursery

Plate 4: Stranagoppoge River 2.8km d/s site boundary: cascade & pool

Upper Stranagoppoge; Tributary 1

This small tributary (Figure 6) runs parallel to the L2033 for 25m and upstream of this veers north-west into conifer and heather where it becomes steep, incised with boulder, cobble and some gravel over small cascades. The lower survey reach parallel to the road was mainly cobble in grade 3 nursery with some areas of unclassified habitat; this reach was covered with a thick layer of orange/ brown sludge indicative of iron oxidising bacterial growth. Below the road, habitat was limited to mainly small pools and poor quality nursery within a thick conifer riparian zone offering little light. Overall, fisheries potential was low (Plates 5 and 6).

Plate 5: Stranagoppoge tributary 1 parallel to road

Plate 6: Stranagoppoge tributary 1 upstream of road within site

Upper Stranagoppoge; Tributary 2

This main tributary is formed by several smaller tributaries (including tributary 3) that coalesce approximately 300m upstream of the L2033 road within the site boundary (Figure 6). Downstream of the road, the section has a series of excellent quality riffles and runs with grade 2 nursery and some deeper pools that would hold adult salmon. A good quality spawning ford (grade 1 and 2) occurs approximately 80m downstream of the road (Plate 7). Upstream of the road within the site boundary, the stream gradient increases sharply with a large cascade/ waterfall located approximately 30m upstream that would be impassable to salmon (Plate 8); 60m above this, high gradient riffles and a series of chutes, cascades and pools offer moderate quality habitat for juvenile trout (see also juvenile fish stock assessment results).

Plate 7: Section of tributary 2 downstream of passable road bridge

Plate 8: Cascades/ Falls in tributary 2 upstream of road

Upper Stranagoppoge; Tributary 3

This tributary flows south within the site boundary to meet with several other small tributaries to form tributary 2 (Figure 6). Approximately 600m upstream of the road in the vicinity of a proposed new access track crossing, the stream was circa. 0.5m wide with fast flow, and a substrate mainly comprised of peat with occasional cobble. The depth was very shallow (0.05-0.1m) despite high flow conditions. There was a high level of orange sludge covering most of the substrate and salmonid habitat quality was poor with most of the channel unclassified except for a few areas approaching grade 3 nursery (plate 9). Overall the reach had very low fisheries potential (also supported by fish survey results; see juvenile fish stock assessment below).

Plate 9: Tributary 3 in the area approximate to a proposed track crossing within the upper part of the site boundary

Plate 10: Tributary 4 upstream of the road bridge looking further towards steeper terrain within the site boundary

Upper Stranagoppoge; Tributary 4

This tributary flows south then east within the site boundary before meeting tributary 2 downstream of the main L2033 road (Figure 6). Just above the road within the site the stream is circa. 0.8-0.9m wide, of shallow depth and largely cobble, boulder and bedrock covered by a thick layer of orange sludge and green algae; habitat here is barely grade 3 nursery and despite good flow and moderate depth, the gradient increases sharply and becomes unsuitable for salmonids (Plate 10). There is a culvert at the road that is perched at its mouth and is impassable to fish. Approximately 500m further upstream in the vicinity of a proposed new track crossing (190652E 397500N), the stream narrows and provides areas of grade 2 nursery with cobble and gravel interspersed with a peat base; habitat is potentially suitable for juvenile trout (Plate 11; but see also juvenile fish stock assessment results).

Plate 11: Tributary 4 circa. 500m upstream of the road bridge

Stracashel; Tributary 5

This tributary flows south/ south-east within the site and just above the road it is very narrow (circa. 0.2-0.3m wide) and shallow with a substrate entirely covered by orange sludge indicative of iron oxidising bacterial growths; fisheries value is low (Plate 12). Further upstream in the vicinity of a proposed new track crossing the stream remains very narrow (0.3-0.4m), shallow and is mainly run flow habitat; substrate is a mixture of gravel/ peat and cobble/boulder consistent with grade 3 salmonid nursery at best (Plate 13; but see juvenile fish stock assessment results).

Plate 12. Tributary 5 section just above road showing thick orange mat growths

Plate 13: Tributary 5 – 200m upstream of road bridge in vicinity of proposed track crossing

Stracashel; Tributary 6

This tributary flows south/ south-east within the site and is joined just above the road by a small tributary 60m upstream (tributary 7; Figure 6). Downstream of the road the channel carves through rough pasture as a series of eroding meanders with good salmonid habitat quality; this is characterised by riffle/ runs over cobble and boulder substrate consistent with grade 1 and 2 nursery habitat, and grade 2/3 holding pools up to 0.4m deep, with pockets of spawning gravel (Plate 14). In contrast, just above the road the channel runs through a forest ride; the channel is incised with poor habitat quality as the cobble and pebble substrate is covered by a thick orange/ brown sludge layer. Most of the reach is unclassified with some areas approaching grade 3 nursery (Plate 15). Above this, the channel narrows further and is largely unclassified habitat unsuitable for trout.

Plate 14: Stracashel; Tributary 6 downstream of road

Plate 15: Stracashel; Tributary 6 upstream of road within forest ride

Stracashel; Tributary 7

This small tributary meets tributary 6 approximately 60m upstream of the road. It has very low fisheries potential and is not apparent as a defined channel in the area of the proposed new track crossing as it represents seepage from the plantation forestry and bog area (see also juvenile fish stock survey results).

Stracashel; Tributary 8

Upstream of the L2033 road, and within the site boundary, the channel is very narrow and presents from seepage approximately 60m further upstream (Plate 16). There is little flow and the substrate is largely peat and clay with small areas of pebbles and fines with a thick cover of orange sludge; the channel in the area of the proposed new track crossing has very low fisheries value (see also juvenile fish survey results below). Downstream of the road the stream is met by another small channel that augments its flow. However, fisheries habitat quality is very poor with shallow depth and a substrate mainly comprised of peat, vegetation and silt with occasional gravels (Plate 17).

Plate 16: Stracashel; Tributary 7 view to confluence with tributary 6

Plate 17: Stracashel; Tributary 8 upstream of road within site boundary

Stracashel; Tributary 9

Upstream of the L2033 road, and within the site boundary, the channel is of high gradient and fast flowing, up to 1.0m wide with bedrock and boulder substrate within a series of long cascades impassable to salmonids (Plate 18). Habitat is unsuitable for fish given the gradient and lack of complex substrate. Similarly, fisheries potential in the vicinity of the proposed new access track crossing also is low (see also juvenile fish survey results). Downstream of the road the channel is similar although of shallower gradient but remains unsuitable for fish. Up to 400m further downstream the gradient becomes more gentle although the channel remains narrow with a depth ranging 0.1-0.35; the substrate is mainly peat with some cobble in an area of extensive sheep grazing – habitat is at best grade 3 nursery or holding but has fisheries potential (Plate 19; but see juvenile fish survey results).

Plate 18: Stracashel; Tributary 9 view upstream of road

Plate 19: Stracashel; Tributary 9 circa. 400m downstream of road (looking upstream)

Stracashel; Tributary 10

Upstream of the L2033 road, and within the site boundary, the stream flows within bog/ heather over a high gradient, incised and very narrow (circa. 0.25m wide) channel consisting of runs, chutes and small cascades indicative of good clean habitat but of very low fisheries potential (Plate 20). Downstream of the road, the gradient remains relatively steep with a mixture of bedrock and cobble in mainly run habitat with rare pools (Plate 21); fisheries potential is poor due to gradient only.

Plate 20: Stracashel; Tributary 10 reach upstream of road

Plate 21: Stracashel; Tributary 10 reach downstream of road

Stracashel River

Above the inflow of all site drainage tributaries (control site 10; Figure 6), the Stracashel River is circa. 2.0m wide and of moderate depth. The channel runs through an area of rough pasture and bog that is grazed by sheep (Plate 22). Habitat is riffle, run and glide with some deeper pools. Substrate is largely cobble and boulder with areas of bedrock and high cover of aquatic moss. Fine sediment cover is low. Salmonid habitat quality is good comprising mainly grade 2 and 3 nursery with grade 3 pools.

Directly downstream of the proposed grid connection cable crossing of the Stracashel River (impact site 13; Figure 6), the gradient is moderate and occurs with a very short reach of grade 2 nursery (Plate 23). However, the gradient becomes very shallow and reflects the abundant deeper water that would provide resting pools for adult salmon and trout, and shallow areas of limited in-stream cover consistent with grade 3 nursery (Plates 24 & 25).

Plate 22: Stracashel River (control reach) upstream of site drainage stream inflows

Plate 23: Stracashel River (cable crossing impact reach) Grade 2 nursery downstream of bridge

For several hundred metres the substrate is of poor to fair quality due to an abundance of fine materials such as pebbles, coarse and fine sand, and considerable fine fragmented peat, and silt. The riparian zone was dominated by grasses with little tree cover and extensive bank collapse due to erosion. The channel had extensive deposits of peat clumps that once dominated the lower layers of the riparian soils; these have entered the channel after bank collapse. Overall, apart from the small reach of grade 2 nursery below the bridge, the channel is of low importance for spawning and nursery but is important for the movement of adult fish to upstream spawning grounds.

Plate 24: Stracashel River (impact reach) Grade 3 nursery 60m downstream of cable crossing

Plate 25: Stracashel River (impact reach) Holding pools dominate for approx. 250m below bridge

The lower Stracashel River (impact site 12; Figure 6) over 6km downstream of the confluence of the most westerly tributary draining the site (Tributary 10) is much wider with excellent quality salmonid nursery habitat. There is no obvious fine sediment and the shallower areas are dominated by riffle, run, glide flow habitat and mainly grade 2 nursery with some grade 3 holding pools (Plate 26). Substrate is a mixture of boulder and cobble with high cover of aquatic mosses and occasional filamentous green algae. There are large deep grade 1 holding pools located further downstream at a series of sharp bends in the river.

Plate 26: Stracashel River (impact reach) 6km downstream of site drainage streams

Juvenile Fish Stocks

The juvenile fish stock survey of the watercourses draining the proposal site was carried out in September 2019 at 18 selected sampling sites, and at an additional site in June 2020 (Stracashel River Site 13; owing to a re-route of proposed grid connection cable), as indicated in Figure 6. Sampling sites were initially selected on each of the main drainage streams at the boundary of the site development (sites 2-9 & 11; Figure 6) and in the main Stranagoppoge and Stracashel Rivers (sites 1, 10, 12 and 13). Additional sites were surveyed downstream of locations where fish were absent or upstream within the site boundary in the vicinity of proposed site tracks.

Trout had a restricted distribution in streams within and immediately downstream of the site boundary (Figure 7). Trout were present only in tributaries 1, 2 and 6, at abundance ranging from Poor to Good, with the latter occurring in the reach below the L2033 road in tributary 6. No fish were present in most of the other drainage tributaries at the road or in the vicinity of proposed track crossings further upstream (e.g. sites 3c, 4b, 5b, 7, 9). In the main Stranagoppoge River downstream of the Site drainage streams (impact reach; site 1), trout occurred at Fair abundance, whereas in the Stracashel River trout occurred at Moderate (control reach; site 10) and Fair abundance (impact reach; site 12).

In all streams draining the immediate site, juvenile salmon were absent except in Tributary 2 where Aged 0 salmon were present at Poor abundance below the road together with moderate numbers of Aged 1 salmon (Figure 8). Salmon also were present in the Stranagoppoge River at Fair abundance (impact; site 1), absent in the Upper Stracashel River above the site drainage streams (control reach; site 10) and present at Excellent abundance in the Lower Stracashel below the site drainage (impact reaches; site 12 & 13).

Population Age Structure

The age structures of the trout and salmon stocks were verified by constructing separate fish length frequency distributions for each species (Figs 9 & 10). Distinctive modes in the length frequency distribution are evident for each species, with the initial mode representing Age 0 fish and the second mode indicating Age 1 or older fish for trout and Age 1 for salmon. The separation of age classes is approximated as follows:

- Trout: Age 0 = 5-9.5 cm, Age 1 and older = >13.5 cm.
- Salmon: Age 0 = 4.5-8.0 cm, Age 1 = 9.5-12.5 cm.

No older age classes of salmon (>Age 1; >13 cm) are evident as they normally migrate to sea in their third year i.e. the Age 1 fish observed in these streams will go to sea as two-year-olds next spring.

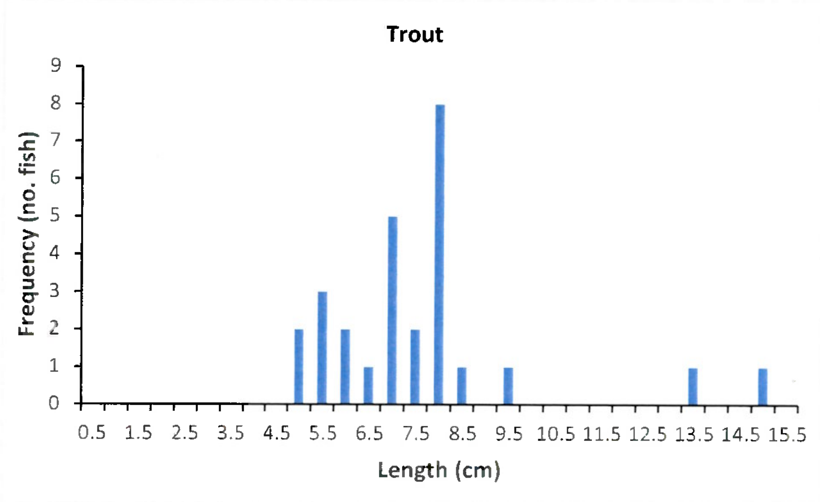

Figure 9: Combined length frequency distribution of trout caught at 7 sites.

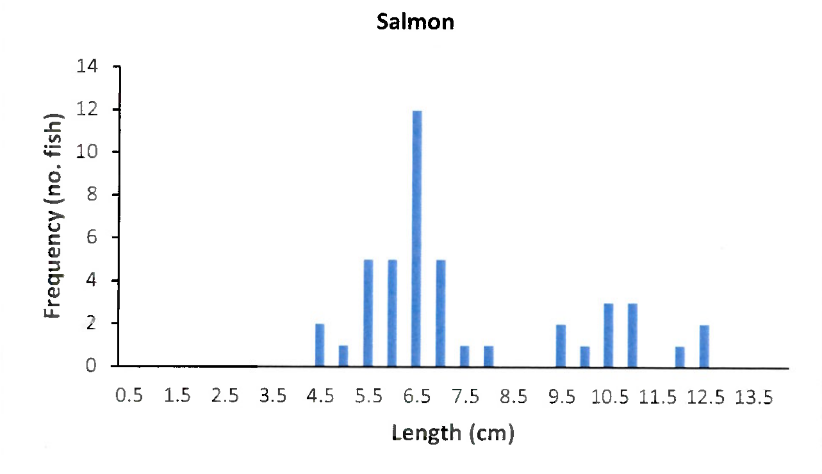

Figure 10: Combined length frequency distribution of salmon caught at 3 sites.

Distribution

The numbers of trout and salmon caught by electrofishing at each site are shown in Table 10.10 with each separated into Age 0 and Age 1 or older.

Table 10.10: Summary results of electrofishing survey, indicating adjusted numbers of age 0 and older trout and salmon caught at each site.

Site	Stream	Grid Ref		Trout		Salmon	
		East	North	Age 0	Age ≥1	Age 0	Age 1
1	Stranagoppoge River (impact reach)	192950	399133	3		10	5
2	Tributary 1	192132	398156	1			
3	Tributary 2	191247	397682	7		2	5
3b	Tributary 2	191200	397762	4	6		
3c	Tributary 3	191219	398142				
4b	Tributary 4	190661	397508				
4	Tributary 4	191166	397637				
5b	Tributary 5	190518	397222				
5	Tributary 5	190635	397094				
6	Tributary 6	190492	396999	16			
7	Tributary 7	190333	397111				
8	Tributary 8	190346	396870				
8b	Tributary downstream of sites 5-8	190972	396261				
9	Tributary 9	190042	396794				
9b	Tributary 9	190208	396259				
10	Stracashel River (control reach)	191009	396264	7			
11	Tributary 10	189725	396086				
12	Stracashel River (distant impact reach)	184958	396289	2		28	8
13	Stracashel River (d/s proposed HV cable crossing)	186588	395911	Not fished			

The occurrence of salmon below the L2033 road in Tributary 2 is consistent with the good quality juvenile habitat and spawning gravels reported in Section 9.4.9 from the salmonid habitat surveys and corroborates results from Loughs Agency juvenile surveys in the same vicinity in 2016 (see Figure 4).

The lack of juvenile salmon at all other drainage streams within the Site boundary is less surprising due to the limited available good quality habitat and/ or steep gradient.

Although trout had a somewhat wider distribution across site drainage streams, fish were absent at many survey sites due to the very poor habitat quality observed and steep gradient. The exceptions were Tributaries 1, 2, and 6, which had moderate to good quality habitat (see Section 9.4.9). Again, the presence of trout with salmon demonstrates that this upper are of the Stranagoppoge is an important spawning area and would be sensitive to development works arising from within the Site boundary. Despite the lack of salmonid fish in most other tributaries within the Site, both salmon and trout occur in hydrologically connected receiving waters, such as the main Stanagoppoge and Stracashel Rivers, which are sensitive downstream receptors, with a crossing of the Stracashel by the HC connector cable also proposed (Site 13).

Stream Quality

Assessment of stream quality was carried out in November 2019 at the survey sites indicated in Figure 6 except for Site 13, which was surveyed in June 2020 owing to a proposed re-route of the grid connection cable.

Chemical Water Quality

Basic water quality parameters were measured in the streams draining the site in November 2019 – a range is indicated for specific conductivity based on an additional measure taken to calibrate electrofishing settings during September 2019. The results are presented in Table 10.11.

Table 10.11: Chemical quality measurements in the main drainage streams.

Site	Stream	Temp (°C)	Dissolved oxygen (mg/l; % sat)	Conductivity (µS/cm)
1	Stranagoppoge River (impact reach)	6.2	12.3; 99%	44-75
2	Tributary 1	6.7	12.3; 98%	51-60
3	Tributary 2	7.3	12.1; 99%	43-58
4	Tributary 4	7.0	11.9; 96%	37-45
5	Tributary 5	7.5	11.0; 91%	67-73
6	Tributary 6	8.1	11.6; 96%	47-60
7	Tributary 7	Tributary 6 downstream assessed		
8	Tributary 8	7.3	11.2; 92%	51-70
9	Tributary 9	6.9	11.7; 95%	52-60
10	Stracashel River (control reach)	6.4	12.1; 96%	56-80
11	Tributary 10	7.8	11.7; 96%	35-85
12	Stracashel River (impact reach)	8.6	11.3; 93%	41-65
13	Stracashel River (impact reach)	12.0	9.6; 98%	105

Dissolved oxygen concentrations were high given the later autumn sampling period for most sites while percent saturation was high in all sites. Conductivity at all drainage tributaries was relatively low (<85 μscm^{-1}) as expected for these low order streams, while values also were low in the main Stracashel and Stranagoppoge Rivers with the highest value recorded in the Stracashel in June 2020 (Site 13).

Biological Quality & Physical Habitat summary

Results from the biological and physical habitat surveys are summarised in Table 10.10 and 10.11. benthic macroinvertebrate community samples were not taken at sites 7 (Tributary 7) and 8 (Tributary 8) owing to the presence of very poor habitat quality (seepage flows).

Site 1; Stranagoppoge River (impact reach)

This site was assigned a Q-value of 4, indicative of Good ecological quality and consistent with Q-values reported by the EPA for the same site in 2016; the high ASPT value (6.75) indicates that the benthic community is represented mainly by pollution sensitive taxa and this also reflects the sediment free moderately complex stream bed, with boulder, cobble and pebble, contributing to a moderately high coarseness index score (Table 10.11).

Site 2; Tributary 1

This site was assigned a Q-value of 3 and an ASPT score of 6.0, with only 11 taxa present at low abundance (Table 10.10). Although the ASPT score reflects largely sensitive invertebrate taxa, the thick layer of iron oxidising bacterial growth contributed to the assignment of the Q value. Despite a cobble dominated bed contributing to moderate coarseness (Table 10.11), habitat quality was undermined by the thick bacterial mats which probably arise because of leaching of deoxygenated groundwater or seepage from the bog upstream.

Site 3; Tributary 2

This site had very high community diversity, reflected in the high Q-value and overall BMWP score, and was dominated by highly sensitive taxa including several plecoptera and ephemeroptera families, which reflect the high ASPT score (Table 10.10). The physical habitat conditions also were optimal in underpinning the diverse invertebrate community due to the high coarseness index, low fine sediment cover, and rapid and dynamic flow environment (Table 10.11). The site also had good abundance of salmon and trout juveniles.

Site 4; Tributary 4

This site had Moderate ecological quality due to the average Q-value and low overall BMWP score; although the ASPT was high (6.5; Table 10.10) due to the presence of several sensitive plecopteran taxa, while the substrate was reasonably complex (Table 10.11), a thick growth of green and orange sludge likely limited community diversity.

Site 5; Tributary 5

Site 5 also had Moderate ecological quality due to the average Q-value and low overall BMWP score but the relatively good ASPT score (6.0; Table 10.10) masks low abundance within each taxon, while the thick orange sludge covering most of the cobble and pebble substrate would limit habitat quality and availability.

Site 6; Tributary 6

Site 6 was assigned a Q-value of 3 and had the lowest overall BMWP, ASPT and number of taxa of any survey site and was estimated as having Poor/Fair ecological quality (Table 10.10). Although substrate was largely cobble and pebble with a moderate coarseness (Table 10.11), the very high percentage cover of the stream bed by iron oxidising bacterial communities most likely reflects poor physical habitat conditions.

Site 7; Tributary 7

This site and tributary was an undefined channel with mainly seepage water and so was not surveyed.

Site 8; Tributary 8

A partial survey of physical habitat was conducted at site 8 because of the limited available survey reach area. The channel was incised with large areas flowing underground to re-emerge in patches of pebble, peat and clay with a high percentage of the bed area covered by orange sludge. The substrate is reflected in the relatively low coarseness index and high fine sediment cover (Table 10.10). No invertebrate sample was taken owing to limited sample area or suitable riffles/ runs.

Site 9; Tributary 9

This site had Moderate ecological quality due to the average Q-value, and moderate BMWP and ASPT scores (Table 10.10). Although the coarseness index was very high (5.15; Table 10.11), this value was skewed by the high proportion of bedrock areas that would limit the availability of good physical habitat quality for invertebrates.

Site 10; Stracashel River – control reach

This site was assessed as having High ecological quality based both on Q-value and a very high ASPT score, which reflect a good diversity of plecoptera and ephemeroptera families (Table 10.10). Fine sediment cover was negligible while substrate coarseness was high due to abundant cobbles and boulders in riffle/ run flow habitat (Table 10.11).

Site 11; Tributary 10

This site was sampled in a very steep fast flowing reach. The Q-value and ASPT score indicated very high ecological quality owing to the presence of good numbers of plecoptera, ephemeroptera and trichoptera families. The paucity of more tolerant invertebrate taxa (e.g. dipterans) is most likely related to the lack of suitable substrate because of large areas of smooth bedrock and limited finer materials.

Site 12; Stracashel River – distant impact reach

This site was assessed as having High ecological quality based both on Q-value and ASPT score, which reflect a diverse community comprising low to moderately sensitive (mollusca, dipterans, and trichoptera) and highly sensitive taxa (plecoptera and ephemeroptera; Table 10.12). The physical habitat also was diverse with low fine sediment cover, a coarse and heterogeneous substrate of pebble, cobble and boulders, and good cover of aquatic mosses. Fine sediment cover was negligible while flow habitat was largely riffle, run, glide with large deep pools (Table 10.13).

Site 13; Stracashel River – impact reach

This site was assessed as having Good-High ecological quality based on Q-value and ASPT score; the high ASPT score reflects a community of moderately sensitive (dipterans and trichoptera) and highly sensitive taxa (plecoptera and ephemeroptera; Table 10.12). Although physical habitat was of only moderate complexity owing to a lack of cobble and boulder, any fine sediment was sourced from sand and fragmented peat that arose from collapsed banks, while flow was largely run and glide/ pool (Table 10.13).

Table 10.12: Invertebrate community summary metrics.

Site	Stream/ River	Q-value	Water/ Ecological Quality	BMWP total score	BMWP-ASPT score	Number of taxa
1	Stranagoppoge River (impact reach)	4	Good	114.9	6.75	17
2	Tributary 1	3	Poor/ Fair	66.2	6	11
3	Tributary 2	5	High	143.4	7.1	20
4	Tributary 4	3-4	Moderate	65.2	6.5	10
5	Tributary 5	3-4	Moderate	59.6	6.0	10
6	Tributary 6	3	Poor/ Fair	52.5	5.8	9
9	Tributary 9	3-4	Moderate	96.6	6.03	16
10	Stracashel River (control reach)	4-5	High	105.4	7.5	14
11	Tributary 10	5	Very High	115.2	8.2	14
12	Stracashel River (distant impact reach)	4-5	High	100.2	6.26	16
13	Stracashel River (immediate impact reach)	4	Good	98.6	7.0	14

Table 10.13: Physical habitat survey summary for watercourses within and downstream of the development.

Site	Stream/ River	Sediment cover (%) & type	Mean width	Mean water depth (m)	Mean flow velocity (ms-1)	Coarseness index (CI)	Substrate heterogeneity (SD)	Inferred substrate
1	Stranagoppoge River (impact reach)	5.2%; sand/ peat	2.9	0.16	0.23	4.04	0.93	Heterogeneous, coarse
2	Tributary 1	3.7; silt	0.96	0.09	0.13	3.5	0.82	Heterogeneous, coarse
3	Tributary 2	2.0; silt	2.15	0.12	0.23	5.0	1.2	Heterogeneous, coarse
4	Tributary 4	5.2; sludge	0.93	0.09	0.13	4.16	0.74	Heterogeneous, coarse
5	Tributary 5	Low; sludge	0.25	0.08-0.14	Low	n/a	n/a	n/a
6	Tributary 6	92; sludge	0.6	0.1	0.14	3.64	0.56	Low heterogeneity; intermediate coarseness
7	Tributary 7	Seepage – not quantitatively assessed						
8	Tributary 8	44; peat, silt, clay	0.52	0.13	0.14	2.57	1.27	Heterogeneous; low to intermediate coarseness
9	Tributary 9	0.5; silt	0.75	0.07	0.12	5.15	1.0	Heterogeneous, coarse

Site	Stream/ River	Sediment cover (%) & type	Mean width	Mean water depth (m)	Mean flow velocity (ms-1)	Coarseness index (CI)	Substrate heterogeneity (SD)	Inferred substrate
10	Stracashel River (control reach)	0.4; silt	2.1	0.22	0.22	4.3	0.75	Heterogeneous, coarse
11	Tributary 10	0.4; sand	0.65	0.07	0.11	5.0	1.13	Heterogeneous, coarse
12	Stracashel River (impact reach)	1.0; sand	7.4	0.23	0.22	3.76	0.83	Heterogeneous, coarse
13	Stracashel River (immediate impact reach)	41; sand & peat	3.9	0.24	0.2	1.7	0.84	Heterogeneous, smooth

10.5.10 Site survey: Cable route and Transport upgrade intersections

Fisheries and general physical habitat

As indicated previously, the proposed cable route will connect the wind farm substation to the Tievebrack station in the west, following the main road and forest track, with a crossing of the main Stracashel River (baseline described earlier). Although remaining within existing road infrastructure - except for the crossing of the Stracashel (which will be under the riverbed via Horizontal Directional Drill, HDD) or where there is insufficient headroom to install the cable above structures such as culverts/ bridges (in which case HDD or damming and diversion will be used) - the cable route will intersect 20 small, largely 1st Order streams, most of which are not designated for Water Framework Directive purposes, and which drain to the Stracashel River (labelled C1 to C19, incl. C5b; Figure 11; Table 10.14).

In areas of proposed road widening and upgrading, there were intersections with an additional 7 small 1st Order non-designated streams that drain to the Stranagoppoge River (RW1-RW7; Figure 11; Table 10.14). The proposed construction of a new access road through Coillte forestry in the east of the development has the potential to intersect the upper reaches of 5 very small drains that flow into the Stranagoppoge River up to 1km downstream (NR1-NR5; Figure 11; Table 10.14). A description of the fish habitat survey findings and potential fisheries sensitivity of each of these streams is summarised in Appendix 1.

Table 10.14: Watercourses intersecting the proposed cable route (Site ID "C"), areas of road widening (Site ID "RW") and the new access road through Coilte land (Site ID "NR") subject to fisheries and general physical habitat surveys.

Site	Name	WFD waterbody ID	Catchment	Activity	Easting	Northing
C1	unknown	N/A	Stracashel	cable	184861	395786
C2	unknown	N/A	Stracashel	cable	184782	395589
C3	unknown	N/A	Stracashel	cable	184800	395559
C4	unknown	N/A	Stracashel	cable	184881	395545
C5	unknown	N/A	Stracashel	cable	185080	395525
C5b	Unknown	N/A	Stracashel	cable	185318	395481
C6	unknown	N/A	Stracashel	cable	185512	395468
C7	unknown	N/A	Stracashel	cable	185749	395487
C8	unknown	N/A	Stracashel	cable	185965	395524
C9	unknown	N/A	Stracashel	cable	186729	396070
C10	unknown	N/A	Stracashel	cable	187000	396127
C11	unknown	N/A	Stracashel	cable	187088	396150
C12	unknown	N/A	Stracashel	cable	187133	396162
C13	unknown	N/A	Stracashel	cable	187399	396225
C14	unknown	N/A	Stracashel	cable	187640	396264
C15	unknown	N/A	Stracashel	cable	187831	396323
C16	unknown	N/A	Stracashel	cable	188274	396572
C17	unknown	N/A	Stracashel	cable	188369	396533

Site	Name	WFD waterbody ID	Catchment	A ctivity	Easting	Northin g
C18	An_Beangan Bui	IENW3836 13	Stracashel	cable	188779	396431
C19	unknown	N/A	Stracashel	cable	190030	396513
RW 1	unknown	N/A	Stranagoppoge	road widening	191842	397995
RW 2	Min An Arbhair	01M64	Stranagoppoge	road widening	192900	399171
RW 3	unknown	N/A	Stranagoppoge	road widening	193417	399280
RW 4	unknown	N/A	Stranagoppoge	road widening	193534	399407
RW 5	unknown	N/A	Stranagoppoge	road widening	193591	399532
RW 6	unknown	N/A	Stranagoppoge	road widening	193724	399700
RW 7	unknown	N/A	Stranagoppoge	road widening	194155	399958
NR1	unknown	N/A	Stranagoppoge	new access rd.	195147	400317
NR2	unknown	N/A	Stranagoppoge	new access rd.	195057	400322
NR3	unknown	N/A	Stranagoppoge	new access rd.	195003	400314
NR4	unknown	N/A	Stranagoppoge	new access rd.	194929	400308
NR5	unknown	N/A	Stranagoppoge	new access rd.	194839	400286

Of the 20 watercourses intersecting the proposed cable route, most were of very low local fisheries significance (C2-C5 incl., C6-C11, C19; Appendix 1) owing to a lack of suitable habitat even for resident trout due to various factor such as very steep gradients; a lack of hard and complex substrate; very shallow depths and/ or low flows (despite surveys occurring after significant rainfall) and complete channel shading. However, all other watercourses intersecting the cable route had the potential to support low (watercourses C5b and C12-C14) to moderate (C1 and C17) trout abundance, with the remainder (i.e. C15, C16 and C18) likely to support good abundance of trout and possibly salmon spawning given the good to excellent quality of habitat observed and their proximity to the nearby main channel Stracashel River (Appendix 1; Figure 11).

Of the 7 watercourses intersecting areas of proposed road widening, most (RW1, RW3,RW4, RW6, and RW7) were of very low local fisheries significance. Two watercourses (RW2 and RW5) had reasonable quality salmonid nursery habitat that had the potential to support resident trout (Appendix 1; Figure 11). It is noteworthy that the watercourse at RW2 occurred near the road turning proposed for significant widening near the Stranagoppoge River, which was surveyed as part of the wider baseline assessment of drainages downstream of the main wind farm development area.

Of the 5 watercourses draining the area of the proposed new access road through Coilte property, four (RW1-RW4) were in steep sheep grazing pasture and bog, drain-like, silted and heavily poached by sheep, so that no suitable salmonid habitat was locally present. However, one watercourse (NR5) occurred adjacent to forestry and was partly fenced with habitat that had some potential to support low numbers of resident trout.

It should be noted that all of these small watercourses (including those of low salmonid habitat quality) occurred upstream of the main Stracashel and Stranagoppoge Rivers, where there are confirmed trout and salmon populations, with FPM also present in the Stracashel River. Therefore, while local fisheries sensitivity of many watercourses is low, there are nearby downstream watercourses with significant fisheries and aquatic ecological interests.

Juvenile Fish Stocks

The juvenile fish stock survey of the watercourses intersecting the proposed cable and transport upgrade locations (see Figure 11) was carried out in July 2021. Of the 20 sites intersecting the proposed cable route (C1-19), five could not be surveyed for fish due to drying or limited water depth and thus very poor habitat quality (Figure 12). Of the twelve road widening (RW1-7) and new access track intersections (NW1-5), nine could not be surveyed owing to drying, seepage flow and or a lack of water depth; all of these sites therefore had very poor habitat quality for the support of juvenile salmonids.

Distribution

Of the sites surveyed, fish (trout and salmon) were absent in all watercourses intersecting the forest track towards the Tievebrack substation. Trout fry were more common in the key watercourses intersecting the cable route along the main road close to their inflow to the Stracashel River (C9-C18) with abundance ranging Fair to Excellent, largely supporting the habitat quality assessments (Figure 12). Of the sites surveyed along the road widening areas and draining the proposed new access road through forestry, trout were present only at RW2 close to its inflow to the Stranagoppoge River, with abundance assessed at "Poor".

Juvenile salmon were more restricted in their distribution, occurring only in five tributaries of the Stracashel that intersected the cable route along the main road (sites C14 to C18), with abundance ranging Fair to Excellent (Figure 13). Salmon presence was generally consistent with the salmonid habitat assessments.

The population age structure of trout and salmon was verified based on the length-frequency histograms outlined previously in Figures 9 and 10. The distribution of trout and salmon caught by electrofishing at each site intersecting the cable route, road widening and the new forest access track are shown in Table 10.15 with each separated into Age 0 and Age 1 or older. Again, the lack of fish, or the inability to fish (NF) in many small watercourses is less surprising given the poor quality salmonid habitat as described in Appendix 1.

Salmon Age 1 or older were absent at all sites. There were few sites in which trout Age 1 or older occurred, being present at low abundance in sites C15, C17 and C18, where habitat quality was good. It is likely that any older trout or salmon would have dispersed into the main Stracashel River, which is a short distance from most cable route intersections.

No other fish species were recovered in any of the sites surveyed.

Table 10.15: Summary results of electrofishing survey, indicating adjusted numbers of age 0 and older trout and salmon caught at each site. NF = not fished due to drying, low water levels or seepage/ unsuitable habitat.

Site	Stream	Trout		Salmon	
		Age 0	Age ≥1	Age 0	Age >1
C1	unknown	0	0	0	0
C2	unknown	0	0	0	0
C3	unknown	0	0	0	0
C4	unknown	0	0	0	0
C5	unknown	0	0	0	0
C5b	Unknown	0	0	0	0
C6	unknown	0	0	0	0
C7	unknown	NF	NF	NF	NF
C8	unknown	NF	NF	NF	NF
C9	unknown	11	0	0	0
C10	unknown	NF	NF	NF	NF
C11	unknown	NF	NF	NF	NF
C12	unknown	2	0	0	0
C13	unknown	14	0	0	0
C14	unknown	7	0	3	0
C15	unknown	70	5	5	0
C16	unknown	35	0	16	0
C17	unknown	25	2	11	0
C18	An_Beangan Bui	23	1	45	0
C19	unknown	NF	NF	NF	NF
RW1	unknown	0	0	0	0
RW2	Min An Arbhair	2	0	0	0
RW3	unknown	NF	NF	NF	NF
RW4	unknown	NF	NF	NF	NF
RW5	unknown	NF	NF	NF	NF

Site	Stream	Trout		Salmon	
		Age 0	Age ≥1	Age 0	Age >1
RW6	unknown	NF	NF	NF	NF
RW7	unknown	NF	NF	NF	NF
NR1	unknown	NF	NF	NF	NF
NR2	unknown	NF	NF	NF	NF
NR3	unknown	NF	NF	NF	NF
NR4	unknown	NF	NF	NF	NF
NR5	unknown	0	0	0	0

10.6 Assessment of Potential Effects

10.6.1 Fisheries and Aquatic Ecological Sensitivity Criteria

Main wind farm site and tracks

Using the information collated in the baseline assessment, the Fisheries and Aquatic Ecological Sensitivity of the key watercourses draining the area within the main wind turbine and access track boundary and downstream sensitive watercourses, is shown in Table 10.16. A watercourse was deemed to have a Very High sensitivity if its ecological quality was Very High and/or it was within a designated site such as an SAC, and/ or Annexe II species were present (e.g. salmon). In contrast, a watercourse was deemed to have Low sensitivity if fish were absent and its ecological/ physical habitat quality was poor.

Of the site drainage watercourses, Tributary 2, the source of the Stranagoppoge, was assessed at Very High sensitivity; although the sections of the stream within the site boundary held only trout, the ecological quality was assessed at High while juvenile salmon and the upper limit of the SAC occurred immediately below the site boundary.
One watercourse, Tributary 10, was assessed at High sensitivity since, although fish were absent due to the high gradient, the ecological quality was assessed at High. Five watercourses within the site boundary were assessed at Medium sensitivity because of the

presence of trout (Tributaries 1 & 6) or Moderate ecological / physical habitat quality (Tributaries 4, 5, & 9). The remaining three watercourses (Tributaries 3, 7 & 8) were assessed at Negligible or Low sensitivity due both to a lack of fish presence and poor/ very poor ecological or physical habitat quality.

Table 10.16: Sensitivity of watercourses draining the main wind turbine and track access site boundary and downstream to the main Stracashel and Stranagoppoge rivers

Watercourse	Key Species/ receptors	Ecological quality	Sensitivity
Site drainage watercourses			
Tributary 1	trout present immediately below Site boundary, Q-value 3; ASPT 6.0.	**Moderate**	**Medium**
Tributary 2	SAC & salmon present immediately below Site boundary; trout present just above boundary, Q-value 5; ASPT 7.1	**High**	**Very High**
Tributary 3	Fish absent; physical habitat poor	**n/a**	**Low**
Tributary 4	Fish absent; fair quality physical habitat; Q-value 3-4; ASPT 6.5	**Moderate**	**Medium**
Tributary 5	Fish absent; poor to moderate quality physical habitat; Q-value 3-4; ASPT 6.0	**Moderate**	**Medium**
Tributary 6	Trout present immediately below Site boundary; good quality physical habitat; Q-value 3; ASPT 5.8	**Moderate**	**Medium**
Tributary 7	Fish absent, very poor physical habitat quality	**Poor**	**Negligible**
Tributary 8	Fish absent; poor quality physical habitat	**Poor**	**Low**
Tributary 9	Fish absent; Moderate quality physical habitat; Q-value 3-4; ASPT 6.0	**Moderate**	**Medium**
Tributary 10	Fish absent due to steep gradient; Good quality physical habitat; Q-value 5; ASPT 8.2	**High**	**High**
Sensitive downstream watercourses			
Stranagoppoge River	SAC & salmon present; trout present; Q-value 4; ASPT 6.75	**Good**	**Very High**
River Finn	SAC & salmon present; trout present;	**High**	**Very High**

Watercourse	Key Species/ receptors	Ecological quality	Sensitivity
Site drainage watercourses			
Stracashel River (inc. sites 12 & 13)	SAC & salmon present; trout present; Q-value 4-5; ASPT 6.26	**Good**	**Very High**
Owenea River	SAC & salmon & FPM present; WFD status Good; trout present;	**Good**	**Very High**

Watercourses intersecting the proposed cable route, areas of road widening and the new access road

Using the information collated in the walkover assessment of salmonid habitat, general physical habitat, and summer 2021 fish surveys, the Fisheries Sensitivity of the key watercourses intersecting the cable route, areas of proposed road widening, the new access road through Coillte land, and downstream sensitive watercourses, is shown in Table 10.17. The same sensitivity criteria applied in Section 10.6.1. were used to grade sensitivity from Very High to Low/ Negligible.

Of the site drainage watercourses intersecting the proposed cable route, the streams at C14 to C18 inclusive were of greatest sensitivity owing to a combination of having good/ excellent salmonid habitat quality, and the presence of trout and salmon fry. The small watercourses at sites C1, C5b, C9, C12, and C13 were assessed as having Medium sensitivity because of moderate quality habitat and thus ecological potential, with trout fry present at C12 and C13. The remaining small watercourses at sites C2-5 and C6-C8 were assessed at Low sensitivity due to habitat that was deemed unsuitable for salmonid fish, and / or lacked fish during fish survey, while sites C11 and C19 were assessed at Negligible sensitivity due to very poor habitat quality.

Of the site drainage watercourses surveyed at additional road widening areas, the stream at RW2 was assessed as having Medium sensitivity because of moderate habitat quality and the presence of trout fry, whereas the remaining small watercourses at sites RW1, RW3-4, and RW6-7, were assessed at Low sensitivity due to habitat that was deemed unsuitable for salmonid fish.

Of the 5 small non-designated watercourses intersecting and draining the area immediately downstream of the proposed new access road, four (NR1-4) were assessed to have at best

"Low" local sensitivity; during fish survey, all four were found to have seepage flow with channels choked by grass such that survey was not possible. One watercourse, (at NR5), draining the western end of the proposed new road, had better potential to support trout but during survey no fish were present possibly due to the high gradient and numerous stepped falls that would be impassable to small trout (Appendix 1).

The assessment of impact is primarily based on the potential effect on aquatic ecology and salmonid fish either directly or upon their habitats. These assessments are equally relevant to the other significant species that may be present in the waters draining the development site such as lamprey and eel. A key aspect of this assessment is the initial appraisal of "Do-Nothing" alternative (as per EPA, 2017).

As for the tributaries draining the main turbine and access track boundary, the Stranagoppoge and Stracashel, and the main Rivers Finn and Owenea, all occur downstream of all cable and road intersections, all occur within SAC boundaries, and have salmon present, while the Owenea also has FPM present. All of these downstream receiving watercourses are assessed at Very High sensitivity (Table 10.17).

Table 10.17: Sensitivity of watercourses intersecting and draining the proposed cable route, areas of proposed road widening, and the new proposed access track through Coilte land (see also Appendix1).

Watercourse	Key Species/ receptors	Ecological potential	Local Sensitivity
Watercourses intersecting proposed cable route			
C1	Habitat suitable for resident trout but fish absent; expect at least moderate ecological quality	Moderate	Medium
C2	Habitat unsuitable for salmonid fish and fish absent; expect Low ecological quality	Low	Low
C3	Habitat unsuitable for salmonid fish and fish absent, expect Low ecological quality	Low	Low
C4	Salmonid habitat quality very poor and fish absent, expect Low ecological quality	Low	Low
C5	Salmonid habitat quality very poor and fish absent; expect Low ecological quality	Low	Low
C5b	Habitat is potentially suitable for resident trout but fish absent; expect Moderate ecological quality	Moderate	Medium

Watercourse	Key Species/ receptors	Ecological potential	Local Sensitivity
Watercourses intersecting proposed cable route			
C6	Salmonid habitat quality very poor and fish absent; expect at best Moderate ecological quality	Moderate at best	Low
C7	Habitat unsuitable for salmonid fish and could not be surveyed; expect Low ecological quality	Low	Low
C8	Habitat unsuitable for salmonid fish and could not be surveyed; expect Low ecological quality	Low	Low
C9	Habitat quality low to moderate and trout present; but expect Low ecological quality	Moderate	Medium
C10	No defined channel apparent and not fished	N/A	N/A
C11	Very poor quality side channel and not fished	Negligible	Negligible
C12	Habitat quality low but with potential to support occasional resident trout; trout present at low abundance expect low ecological quality	Low	Medium
C13	Habitat quality low but with potential to support occasional resident trout; trout fry present; expect low ecological quality	Low	Medium
C14	Habitat quality low but with potential to support occasional resident trout; trout & salmon fry present; expect low ecological quality	Low	Very High
C15	Habitat is suitable for trout spawning & recruitment, & possibly salmon; trout & salmon fry present; expect moderate ecological quality	Moderate	Very High
C16	Moderate salmonid habitat quality; trout likely & salmon possible; trout & salmon fry present; expect at least moderate ecological quality	Moderate	Very High
C17	Habitat is potentially suitable for resident trout; trout & salmon fry present; expect Moderate ecological quality	Moderate	Very High
C18	Salmonid habitat quality is excellent with high trout potential and possible salmon; trout & salmon fry both present at Excellent abundance; expect at least Good ecological quality	Good	Very High
C19	Habitat quality very poor and unsuitable for salmonid fish; not fished; expect Low ecological quality	Low	Negligible
Watercourses intersecting proposed road widening areas			

Watercourse	Key Species/ receptors	Ecological potential	Local Sensitivity
Watercourses intersecting proposed cable route			
RW1	Habitat quality low and unsuitable for salmonid fish; no fish present; expect low ecological quality	Low	Low
RW2	Moderate salmonid habitat quality; trout likely; trout fry only; expect at least moderate ecological quality	Moderate	Medium
RW3	Habitat quality low and unsuitable for salmonid fish; not fished; expect low ecological quality	Low	Low
RW4	Habitat quality low and unsuitable for salmonid fish; not fished; expect low ecological quality	Low	Low
RW5	Habitat quality low but some potential for resident trout; not possible to fish; ; expect low ecological quality	Low	Low
RW6	Habitat quality low and unsuitable for salmonid fish; not fished; expect low ecological quality	Low	Low
RW7	Habitat quality low and unsuitable for salmonid fish; not fished; expect low ecological quality	Low	Low
Watercourses draining proposed new access road through Coilte land			
NR1	Habitat quality low and unsuitable for salmonid fish; not fished; expect low ecological quality	Low	Low
NR2	Habitat quality low and unsuitable for salmonid fish; not fished; expect low ecological quality	Low	Low
NR3	Habitat quality low and unsuitable for salmonid fish; not fished; expect low ecological quality	Low	Low
NR4	Habitat quality low and unsuitable for salmonid fish; not fished; expect low ecological quality	Low	Low
NR5	Habitat quality low but some potential for resident trout; no fish present; expect low ecological quality	Low	Low
Sensitive downstream watercourses			
Stranagoppoge River	SAC & salmon present; trout present; Q-value 4; ASPT 6.75	Good	Very High
River Finn	SAC & salmon present; trout present;	High	Very High
Stracashel River	SAC & salmon present; FPM present, trout present; Q-value 4-5; ASPT 6.26	Good	Very High

Watercourse	Key Species/ receptors	Ecological potential	Local Sensitiv ity
	Watercourses interse cting pro posed cable route		
(inc. sites 12 & 13)			
Owenea River	SAC & salmon & FPM present; WFD status Good; trout present;	Good	Very High

10.6.2 "Do-Nothing": Landscape, Land-Use and Climate Change

"Do Nothing" Impact

If the proposed wind energy development, its associated works and infrastructure does not proceed, it is assumed that the character of the landscape and its uses will remain much as they are today i.e. rough grazing, peat extraction and commercial forestry growth. The proposed change in land use for wind energy would be superimposed over the existing uses during the lifetime of the proposed development (25 years). If the proposed development does not proceed, the projected generation of electricity from a renewable source and will not take pace and therefore a net reduction in greenhouse gas emissions will not occur. It follows therefore, that there will be no contribution to the slowing or reversal of climate change.

The potential impacts of Climate Change on Ireland's Biodiversity was assessed by Sweeney et al. (2003) and showed that fish species such as salmon were particularly susceptible to climate change-related increases in temperature and rainfall. Increasing water temperatures will alter aquatic communities in general while higher temperatures may reduce salmon egg survival, retard fish growth, and increase stress and susceptibility to disease with potential impacts on smolt migration timings and survival. The potential effect of temperature regime changes on the marine environments productivity has been well documented and this also could influence salmon marine survival. Increasing intensity and frequency of rainfall events may also lead to more concentrated periods of rain resulting in flash floods and wash-out of spawning gravels.

It is therefore possible that part of the cumulative 'Do Nothing' impact for this and other renewable energy developments will accelerate the loss of salmon and other aquatic species from their range of distribution in Ireland as a whole.

"Implementation" Impact

Implementation of the proposed development will provide green energy that can partly replace power generation methods that produce carbon dioxide emissions. The development will be responsible for virtually no carbon emissions in the operational phase, and will contribute to the slowing or reversal of climate change.

10.6.3 Construction Phase

Construction phase impacts cover sediment run-off, release of other pollutants, and temporary interruption of fish passage.

Cable installation

For the installation of the connecting cable between the Wind Farm substation and the Tievebrack Station, the route will follow the public road before crossing the main Stracashel River, after which it will follow a forestry track to the main Tievebrack Station. Several methods will be used to deploy the cable at watercourse crossings depending on individual site conditions (as per Attachment 7 (Construction Methodology – Graffy Wind Farm – 100kV Undergorund Cable prepared by TLI group) of the Construction Environmental Management Plan (CEMP; Keohane, 2021);

- Cutting and filling of open trench within the existing road above the watercourse: - i.e. above a culvert/ bridge unless there is insufficient headroom in which case the intention is to come "off-line" and install the cable as follows;
- Beneath the riverbed after damming and diversion of water over or around the works.
- Trenchless beneath the riverbed by Horizontal Directional Drilling (HDD);- HDD is a trenchless crossing method that uses a steerable method of installing the cable in an arc along a prescribed bore path under the riverbed using a surface-launched drilling rig. Drilling is assisted by pumped pressurised drilling fluids, comprising a mixture of freshwater and a bentonite clay-based lubricant.

For HDD, there will be no direct contact with a stream or riverbed, although there remains the possibility of sediment run-off from excavation of a trench within the existing road/ track.

Cable installation at culverts requiring damming and diversion/ fluming

Given the depth and construction of some existing culverts, they will require replacement as part of the cable construction and installation works while others will require nearby works that involve damming and diversion/ fluming to install the duct and cable (Attachment 7, CEMP; Keohane, 2021). This work will take place in a dry stream bed to mitigate the ingress of sediment and other pollutants. Several methods are proposed that involve damming, water diversion, and reinstatement of the stream bed. Works are anticipated to require 1-2 days for completion with full details outlined in the CEMP (Keohane, 2021) and summarised as follow;

1. Damming and Fluming

- A flume pipe will be set on the bed of the existing stream
- A dam will be constructed using sand bags and packing suitable material around the flume to seal it to direct flows over the works are and into the flume pipe.
- Silt traps, geotextile membrane, and straw bales will be placed downstream of the in-stream trench location prior to construction to minimise silt loss
- Installation of the cable duct will be carried out in the dry under/ around the flume pipe. If necessary, a temporary sump will be created to dewater the area, which will be removed by pumping to a percolation area of unsaturated soil, otherwise, a settlement tank will be used to remove any solids from dewatering.
- Reinstatement of the original stream bed will follow by using the original material or similar material and any cobble/ gravel replaced under supervision of the aquatic ecologist/ fisheries biologist.
- Once the stream bed is reinstated, the dam and flume pipe will be removed
- Reinstatement of the original stream bed will follow by using the original material or similar material and any cobble/ gravel replaced under supervision of the aquatic ecologist/ fisheries biologist.
- Once the stream bed is reinstated and the flume pipe removed, the dam will be removed and the stream restored to its original condition

2. Damming and Diversion

- A channel will be excavated adjacent to the original stream channel

- Bedding stone will be placed on the bed of the new channel
- A dam will be constructed using sand bags and material as above so that the flow is diverted to the new temporary channel.
- Silt traps, geotextile membrane, and straw bales will be placed downstream of the in-stream trench location prior to construction to minimise silt loss
- Installation of the cable duct will be carried by excavation within the dry dewatered (and now temporarily diverted stream bed). If necessary, a temporary sump will be created to dewater the area, which will be removed by pumping to a percolation area of unsaturated soil, otherwise, a settlement tank will be used to remove any solids from dewatering.
- Following the installation of the cable ducts, the stream bed will be reinstated with original or similar material and the spawning gravels replaced under the supervision of an aquatic ecologist.
- Once the stream bed is appropriately reinstated, the dam will be removed thus restoring the stream
- The temporary channel will be in-filled with its original excavate material in isolation from the nearby stream.

Both damming and fluming, and damming and diversion, have the potential to cause loss of *in-situ* species such as trout and salmon by compaction/ removal during excavation, ingress of sediment and other pollutants, temporary obstruction of fish passage, and the loss of sensitive habitat.

3. Replacement of existing culverts

This approach will be required where there is inadequate headroom or where the structural integrity of an existing culvert (e.g. stone culvert) indicate a risk of collapse during trenching works. Works will occur in the dry as per damming and fluming methods above and a trench excavated for the duct and cable as follows;

- Where applicable, under the supervision of an aquatic ecologist, spawning gravels will be removed at the watercourse crossing location.
- The old culvert will be removed using an excavator.
- A new HDPE or precast concrete pipe or box culvert will be installed in the watercourse. The new structure will be installed 300mm below the original bed level.

- The spawning gravels will be replaced under supervision of an aquatic ecologist both upstream, downstream and inside the new structure. Washed gravel will be added to the stream bed if required by the aquatic ecologist.
- Crushed stone will be laid over the culvert and built up in layer to provide vehicular access across the watercourse.
- The surface/road level will be reinstated as per the existing track/road requirements.

This method has the potential to cause loss of *in-situ* species such as trout and salmon by compaction/ removal during excavation, removal of incubating salmonid eggs, ingress of sediment and other pollutants, temporary and permanent obstruction of fish passage, and the loss of sensitive habitat.

Sediment Run-off

Fine sediment (grain size <2mm) is the major cause of documented negative environmental impacts during the construction phase of infrastructure projects that are adjacent to or cross watercourses (Newcombe and Jensen, 1996; Turley et al. 2014; Lawler et al. 2017). Brown trout and Atlantic salmon are highly vulnerable to suspended and deposited sediment in spawning and nursery habitats (Cowx and Welcome, 1998; Kemp et al. 2011). Suspended sediment can lower water clarity leading to reduce prey capture efficiency and may affect respiration rates by clogging of gills while deposited sediment can reduce habitat complexity and quality by in-filling of substrate, and have indirect effects on growth and survival by reducing habitat quality of fish prey species (Suttle et al., 1994). O'Connor & Andrew (1998) examined the characteristics of the riverbed for salmon spawning in the River Bush and found that alevin survival was closely related to the level of fines with impacts detectable at 10% fines.

Freshwater benthic macroinvertebrates are also an important component of river ecosystems, acting both as sentinels of general water and habitat quality, and as an important food resource for higher trophic levels. Fine sediment pulses can cause behavioural drift, whereas habitat quality is impaired due to smothering and blocking of interstitial spaces and water flow (Allan, 1999). Increasing level of fine sediment result in the replacement of sensitive taxa (mayfly, stonefly and caddis) by more tolerant types (worms, midge larvae, molluscs;

Matthaei et al. 2006; Kemp et al. 2011). A change in in invertebrate community structure therefore has the potential to have direct impacts on fish populations.

Fine sediment was partly managed by the water quality objectives and standards of the EC Freshwater Fish Directive 2006/44/EC (FWFD), where a mean total suspended solids (TSS) concentration of 25 mg/L was specified for salmonid waters. Article 6 of the Water Framework Directive has now repealed the FWFD, but new standards that provide the same level of protection have been proposed (WFD-UKTAG, 2010). All waters designated under the EC Freshwater Fish Directive are included as or within water bodies under the WFD. In essence, water quality standards and monitoring requirements to ensure the protection of coarse and game fisheries are covered by the standards and procedures of the WFD. There are no standards for deposited fine sediment in Ireland, however, fine sediment above a threshold of 20% bed cover, based on recommendations in New Zealand by Clapcott et al. (2011), and published research (e.g. O'Connor & Andrew,1998; Kemp et al. 2011), provides a general indication of increasing risk to aquatic ecological health and fish.

Sediment run-off could result from:

- Excavations associated with construction of access tracks and turbine foundations
- Surface peat disturbance and subsequent erosion of the underlying soils
- Stockpiling of soils and excavated materials
- Run-off from access tracks
- Erosion of sediment from constructed drainage channels
- Excavations associated with installation of culverts for watercourse crossings

Much of the natural drainage at each site will be by direct run-off and when the ground is saturated a high percentage of the rainfall will run off quickly to receiving watercourses. The main risk to these streams will therefore be during and following periods of heavy and sustained rainfall; such events are more likely during the autumn/winter period. There is a direct hydrological connection between the proposed site and the Stranagoppoge and Stracashel Rivers, both important salmon rivers in this River Basin District, and therefore a potential route for suspended solids to reach key areas of the river.

Sediment Run-off – peat slippage risk

Several Wind Farm projects in Ireland, such as Derrybrien in Galway, and Meenbog in Donegal, have been associated with slippage of peat leading to contamination of watercourses with suspended sediment/ peat. Chapter 6: Soils, Geology and Hydrogeology, provides an assessment of the construction-related peat landslip risk at Mully-Graffy; this assessment concluded that there is a Negligible risk of construction-related peat landslide for the wind farm development zones and the transport upgrade route. In that assessment, Negligible was associated with the following suggested action 'Project should proceed with monitoring and mitigation of peat landslide hazards at these locations as appropriate'.

Impact Assessment

The construction of the Wind Farm is estimated at 12 months with most earth works conducted between 6-8 months. Without mitigation, the potential impacts from run-off of sediment and suspended solids on fisheries and aquatic ecology would vary depending on the sensitivity of each of the Tributaries as follows:

- Negative
- Slight (low sensitivity), Moderate (Medium sensitivity) or Significant (High to Very High sensitivity)
- Likely
- Short-term (one to seven years)
- Indirect

Mitigation (by Avoidance)

It is important that sensitive aquatic areas of the site should be avoided during the construction phase. To this end a 50m wide watercourse buffer zone associated with construction works for the turbine bases has been recommended with regard to watercourses as detailed in Chapter 7: Hydrology. However, the proposed location of Turbine 6 is between small tributaries that form as Tributary 6 (Figure 6), and the turbine will be 25m from the nearest of these tributaries (Dan Keohane, pers. comm.).

While the number of watercourse crossings have been minimised in the design of the proposed access tracks, a series of mitigations are recommended below to reduce run-off of suspended sediment and its associated environmental impacts.

Mitigation (by Design)

Chapter 7: Hydrology, describes a series of mitigation measures that will be implemented during the construction phase to ensure that there will be a negligible impact on the suspended sediment load in surface waters draining from the main wind farm site and cable installation locations; a summary is provided below;

- Construction phase best practice to minimise the release of sediment laden storm water run-off
- Appointment by the developer of an Ecological Clerk of Works (ECoW) for the duration to monitor all environmental aspects including water quality and performance of water management infrastructure. The role and responsibility of the ECoW is outlined in the Construction Environmental Management Plan (CEMP; Keohane Geological and Environment, May 2021) and with reference to sediment management.
- All clean surface water run-off will be diverted around earthworks to minimise potential volume of listed water generated
- Areas stripped of vegetation will be minimised while all areas along road verges and hardstands will be reinstated and landscaped on an ongoing basis. Peat turves will be placed on the surface to expedite restoration.
- Stock-piled soils will be maintained at a minimum 50m distance from any watercourse
- A water treatment train will also be put in place to filter and treat all surface discharge water collected in the dirty water drainage system
- Silt fences will be deployed down-gradient of construction and stock-piled areas that drain towards on-site natural streams.
- Drainage swales will be constructed at track edges and where discharge occurs into forestry drains for road sections within forestry; as forestry drains are blocked with needles and debris, flows will be slowed and mobile sediment trapped.
- For works adjacent to roads, check dams and/ or straw bales will be installed along the alignment of roadside drainage
- Works near stream crossing will be conducted in dry weather
- A pre-emptive site drainage management plan will be applied to take account of predicted rainfall so that large excavations and internal transportation of peat/subsoil or vegetation stripping can be suspended or scaled back when heavy rain is forecast.

Within the main Wind Farm site; with regard to the tributary crossings at new access tracks, the following crossing methods will be employed;

Tributary 3 – 450mm HDPE pipe culvert;

Tributary 4 – bottomless / clear spawn structure;

Tributary 5 – bottomless / clear spawn structure;

Tributary 6 – 600mm HDPE pipe culvert;

Tributary 8 lower – 450mm HDPE pipe culvert;

Tributary 8 upper – 450mm HDPE pipe culvert;

Tributary 9 – 450mm HDPE pipe culvert;

Although bottomless culverts will be used at two access track crossings – thus avoiding instream works and disturbance of banks, it is recognised that some disturbance and sediment release will occur during placement of both bottomless and pipe culverts to provide plant access. Additional mitigations regarding the timing of these works (see below) will reduce the risk to sensitive fish species either in the vicinity (or in downstream sensitive sections). Where near-stream construction work is required, silt fences will be erected immediately down-gradient of the construction area and maintained during the construction phase. No plant will cross streams without installed crossings.

These measures will prevent the run-off of excess sediments via the streams directly draining the site and to key adjoining watercourses, in particular the Stranagoppoge and Stracashel Rivers.

<u>Mitigation (by Timing of Works)</u>

Guidelines for fisheries protection during construction works have been published by both Inland Fisheries Ireland (IFI, 2016) and the Loughs Agency (2011b); each document recommends that instream river works should be avoided during the salmonid spawning season and egg incubation phases, 1 October – 30 April. Where temporary stream works are required, these timing restrictions will apply, for example, Tributary 2 is the only key tributary within the main wind farm site boundary where trout are present; although no access track is proposed to cross Tributary 2, any proposal to conduct in-stream works here will be avoided between 1 October and 30 April.

The restrictions on timing of in-stream works also will apply to all other proposed crossing within the main Wind Farm development boundary where new access tracks are proposed; although most sites had no fish present in the locality of the proposed crossing, any sensitive stages of trout and/or salmon in downstream drainage watercourses will be vulnerable to sediment and other potential pollutants released from upstream. It also is recommended that to minimise the risk of suspended sediment entrainment in surface water run-off, that the windfarm site drainage management system is constructed during periods of low rainfall and therefore minimum run-off rates.

Along the cable route, for any watercourse indicated to be at least of Medium sensitivity (habitat with high potential to support trout and trout confirmed present), instream works will be avoided between 1 October and 30 April (as indicated above). This mitigation also applies to any instream works or culvert replacement at site RW2 where road widening is proposed.

Mitigation (by translocation of fish)

Where salmon and trout are present in any watercourse in which in-stream works are required, all fish within the designated area will be translocated upstream away from the works immediately prior to their commencement, or distantly downstream if this is constrained by impassable barriers. The procedure will occur only within the time window permitted for instream works by IFI/ Loughs Agency, which is a standard mitigation where there is potential to interfere or stress fish by generation of sediment, causing compaction, or removing in-stream habitat (and possibly fish). A fisheries biologist will be required to conduct the fish translocation by electrofishing under a Section 14 license authorisation issued by the Department of Communications, Climate Action, and Environment (DCCAE).

All stream crossings proposed at new site access tracks within the Wind Farm area (Tributaries 3-9) occur where baseline surveys indicated no local presence of fish and generally habitat with low fisheries potential; works at these sites would not require fish translocation.

For the cable route, fish surveys conducted in July 2021 indicated the presence of trout and/ or salmon at C9 and C12-C18 inclusive; fish translocation will be required at these sites where temporary flume pipes will be placed or where replacement culverts are planned (see below). Note that any instream works or culvert replacements at areas designated for road widening, such as RW2, also will require fish translocation prior to works commencing.

Residual Impacts

With the recommended mitigation measures in place the probability of residual impacts from run-off of suspended solids will be Unlikely (i.e. "effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented"; EPA guidance Table 10.5) and the impact on the quality of the attributes assessed, including fish, fish habitat, and aquatic ecology, will be Neutral (i.e. "No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error"; EPA guidance Table 10.5).

Trenchless crossings: HDD drilling mud pollution

As indicated above, there is the possibility of using HDD as an alternative method of installing the cable connection underneath several watercourses where overlying bridges/ culverts have insufficient headroom. HDD may result in the escape to the watercourse of pressurised drilling fluids (bentonite/ mud) through rupture or "break-out" of the underlying bed material and movement beyond the base of the structure or from surface run-off caused by drilling fluid returns at launch (entry) and receiver (exit) pits. Although drilling mud escapes will have similar impacts on aquatic biota and habitats as described for fine sediment above, deposition rates of drilling mud are likely to far exceed background levels owing to the density of the fluids, and may have greater magnitude of impact because of the much finer material released and its greater potential infiltration of the riverbed. The additives in bentonite clay may also cause toxicity; for example, added starches can have very high biochemical oxygen demand (BOD) while lignosuphates may be acutely toxic. While the risk of rupture is considered low, it is dependent on the overlying geology and porosity, coupled with the pressure of drilling fluids (DFO, 2007).

Impact Assessment

Where HDD is required for the installation of the cable, the construction will occur over a period of several days. Without mitigation, the potential impacts on fisheries and aquatic ecology from escape of drilling mud into a watercourse would vary depending on the sensitivity of each of the watercourse as follows:

- Negative
- Moderate (low sensitivity), Significant (Medium sensitivity) or Very Significant (High to Very High sensitivity; e.g. main Stracashel River crossing or C14 to C18 inclusive)
- Unlikely

- Medium-term (7-15 years) or perhaps longer depending on the type and severity of any release
- Indirect

The main effects arising from such an escape could be medium to long-term as a result of either fish mortality, FPM mortality and loss of population viability/ future persistence (e.g. Stracashel River and tributaries), habitat loss/ deterioration and the deterioration in Water Framework Directive informed ecological status. The risk of rupture from trenchless crossings conducted in sites of low local sensitivity (Poor physical habitat quality and ecological status) may still potentially cause impacts of Moderate magnitude on attributes such as invertebrate communities and on more distant sensitive downstream receiving reaches and connecting watercourses.

Mitigation (by Design)

If sufficient headroom is available at a cable watercourse intersection, then the cable will be installed by trenching above the culvert pipe/ bridge so that HDD is avoided.

At each HDD crossing, a geo-technical investigation will be undertaken to determine the porosity of the underlying stream bed and to locate a suitable clay/ silt formation so that the risk of drilling mud break out can be ascertained. The depth of the bore may be increased subject to the investigation. Spatial buffers and sediment traps/ booms will protect sensitive waterways where HDD is undertaken. Construction of settling basins/ containment pits at drilling exit/ entrance points will contain drilling fluids/ drill cuttings. Drilling fluid leakage and bank-side disturbance will be prevented by ensuring that drill launch and receiver pits, are sufficiently distant from watercourses.

The CEMP contains two document attachments that outline the method for HDD (Attachment 6: Method Statement Horizontal Directional Drilling, Keohane, 2021) and the emergency plan to manage the risk of a drilling mud escape/ frac-out (Appendix B, Attachment 7: Construction Methodology Graffy Wind Farm – 110kV Underground Cable; Keohane, 2021). These documents detail the following distance of the drill launch and receiver pits at each of the three watercourses where HDD is proposed;

- Coillte Bridge (cable intersection, Stracashel River) – 50m from river
- Triple Culvert (cable intersection, Stream C15; Culvert no. 27) - 25m from river
- Public Road bridge (cable intersection, Stream C18) 20m from river (on the road)

The frac-out plan outlines a clear process including;

- Full briefing of personnel with the plan and risks involved
- Monitoring of drilling fluid pressure and viscosity by a fluid technician to ensure that readings are within expected values; any change indicative of the risk of a frac-out will be investigated and drilling ceased in such cases.
- A frac-out watch programme will be implemented whereby "spotters" will monitor the ground surface above the drill path and the bed of the watercourse. If a frac-out occurs, drilling will be suspended and the frac-out will be contained using the following measures;
- Sand bag containment at launch pits and riparian area
- Available on-site tractor and bowser
- Pumps
- Physical plugging of the reamed bore using Enviro Formfill

Drilling slurry (drilling fluids and cutting) will be removed safely and disposed of (e.g. use of a vacuum lorry). Chapter 7: Hydrology states "*On completion, drilling water will be slowly released into a percolation pit. If percolation is too slow, the drilling water will be collected and taken to a wastewater treatment plant. Used drilling water will not be released to drains*'. In Attachment 7 of the CEMP it states - *The steel boxes will be removed, with the drilling fluid disposed of to a licensed facility*"

The CEMP includes a Chapter that details an Emergency Response Plan (ERP) with a section covering the response to an accidental break out of silt (Keohane, 2021). The ERP includes recommendations for points of contact and methods of liaison with the EPA and Donegal District Council and the process for conducting an emergency clean up. The CEMP is a draft document as there are no contractors appointed and will be updated on appointment of a contractor. Implementation of the above mitigations will mean that drilling fluid will be unlikely to leak to a watercourse. Again, the term "unlikely" refers to "effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented (see EPA guidance; Table 10.5).

<u>Residual Impacts</u>

With the recommended mitigation measures in place the probability of residual impacts from drilling mud break out caused by trenchless HDD will be Unlikely with an impact on the quality of fish, their habitat and aquatic ecology of Neutral.

Trenchless crossing: drilling noise and vibration

This potential impact is specific to HDD crossings where vibration and noise is caused by drilling machinery or the pumping of bentonite fluid. Vibration and noise may disrupt migratory behaviour and cause injury at test sites with sensitive fish species such as salmon, trout, lamprey and eels. Vibration has the potential to cause damage to incubating eggs in salmonids. Mechanical shock is a well-known causative factor for mortality during the egg incubation stage following fertilisation, when sensitivity is extremely high (Crisp, 1993; Jensen, 2003). However, rotational HDD activity will not involve repeated percussive blows such as would occur with pneumatic pipe ramming or pile-driving, and so vibration is not likely to have a significant impact on sensitive species.

Impact Assessment

Without mitigation, the potential impacts from drilling noise and vibration on fisheries and aquatic ecology would vary depending on the sensitivity of each of the Tributaries as follows:

- Negative
- Imperceptible (low sensitivity), Not significant (Medium sensitivity) or Slight (High to Very High sensitivity)
- Likely
- Brief (less than 1 day)
- Indirect

Any effects of drilling noise and vibration are expected to be Slight for sites of High to Very High sensitivity because of the use of low ration rotational drilling (HDD and Auger bore) that may at worst cause behavioural avoidance in fish. For example, "Slight" is defined in EPA guidance (Table 10.5) as "An effect which causes noticeable change in the character of the environment without affecting its sensitivities".

Mitigation (by Timing of Works)

Although drilling noise and vibration caused by HDD (Stracashel River and possibly for cable installation at some tributaries of the Stracashel) is expected to have at worst only

Slight significance of effect at Very High sensitivity sites, it is recommended that such works are scheduled in consultation with Inland Fisheries Ireland or Loughs Agency with a view to derogation of any seasonal restrictions. For example, in the event of a trenchless crossing being required during the critical period of adult salmonid upstream migration, spawning, and fry development (October 1st to April 30th), consultation would be required with IFI or Loughs Agency on a case by case basis.

Residual Impacts

With the recommended mitigation measures in place the probability of residual impacts from noise and vibration potentially caused by trenchless crossing methods will be Unlikely with an impact on the quality of fish, their habitat and aquatic ecology of Neutral.

Potential release of other pollutants

As the proposed site drains to a series of salmonid rivers, notably the Stranagoppoge/ Finn and Stracashel/ Owenea, in the event of a potential spillage or release of plant fuel, oil or other polluting substances, this could reach important sections of river with consequences for resident fish together with invertebrate organisms, including Annex II listed Atlantic salmon and FPM. Oils and petroleum in particular can have large impacts on aquatic species, ranging from altering oxygen exchange at the water-air interface or causing complete elimination of invertebrates and fish (Mason, 1997). Similarly, the application of concrete slurries in construction processes, such as for turbine foundations, carries some risk of inadvertent discharge with the potential to impact on resident fish and invertebrate organisms in these watercourses. Any chemical spill associated with construction (e.g. concrete slurry) or fuels/ oils from plant, could potentially cause impacts that are Very Significant because of direct toxicity and effects on sensitive downstream watercourses with a Medium-term duration because of potential environmental persistence of these pollutants.

Impact Assessment

Without mitigation, potential impacts from the release of pollutants on fisheries and aquatic ecology would be:

- Negative
- Very Significant
- Unlikely but possible

- Medium-term (7-15 years) or perhaps longer depending on the type and severity of any release

Mitigation (by Design)

Chapter 7: Hydrology, outlines a series of measures to manage the probability of runoff of hydrocarbons and concrete while the CEMP specifies contractor requirements to prevent their run-off to watercourses as follows;

- Storage of fuels on-site to be minimised
- On site re-fuelling of machinery using mobile double-skinned fuel bowser according to clearly defined refuelling protocol.
- Capacity of bunding around fuel storage tanks of 110%
- Re-fuelling to take place at least 50m out with a watercourse
- Identification of designated rinse down areas for concrete contamination of plant
- Provision of Tool-box talks to plant personnel on sensitive receptors within the site
- Concrete pours to occur in contained areas and rinsing of plant at dedicated locations

The proposed drainage system for the site will also facilitate the interception of diesel, oil or other polluting substances during the construction phase, and avoid pollutant release beyond the site boundary.

Mitigation (by Management)

All appropriate precautions will be taken to avoid spillages of diesel, oil or other polluting substances during the construction phase. This may be achieved through good site practices and in line with EPA Integrated Pollution Prevention Control procedures. An Ecological Clerk of Works (ECoW) will be employed by the contractor for the project duration and will oversee environmental good practice and monitor potential impacts on watercourses. The ECoW will oversee the development of the ERP to manage the response in the event of a serious pollution incident (see mitigation under Trenchless Crossing: HDD Drilling mud pollution above).

Mitigation (by Monitoring)

Section 5 of the CEMP provides an overview of environmental controls and includes a sub-section on the requirements for water quality monitoring including:

- ECoW to undertake weekly inspections at all outfalls

- ECoW to monitor water chemistry (colour, suspended solids, nitrate, nitrite Dissolved Reactive Phosphates, Ammonical Nitrogen, Turbidity, BOD, Free Ammonia, Total Phosphorus and TPH) at a series of pre-define monitoring sites in streams draining the development. Frequency of monitoring will vary from continuous to monthly depending on location. Continuous monitoring of the turbidity baseline 1 month prior to works commencing will be used to establish a proxy measure for TSS and to inform a trigger threshold value for alarm sensing during the construction phase. When an alarm value is triggered, this will permit a reactive response (e.g. settlement pond outflow shut-off).
- Within 12-months of the completion of the development, a qualified ecologist will be appointed to undertake macroinvertebrate monitoring at key watercourse locations upstream and downstream of the development in order to compare values with the pre-construction baseline (see current report).

Residual Impacts

With the recommended mitigation measures in place the probability of residual impacts from the release of pollutants will be Unlikely with an impact on the quality of fish, their habitat and aquatic ecology of Neutral.

Fish passage: temporary obstruction

Improperly managed instream or bank works at watercourse crossing points could result in obstruction of the stream channel during periods of upstream fish migration prior to spawning or natural in-stream movements for non-migratory resident brown trout. Obstructions to fish passage can be due to physical or hydraulic causes, while significant noise and vibration may also inhibit movement. There is a very low potential for this type of impact within the area immediate to the turbines and site access tracks because of the lack of suitable habitat and/ or fish at site access track crossings. However, works that are planned in any other watercourse, such as lower Tributary 2, or sites of at least medium sensitivity along the proposed cable route where culvert replacement or damming and diversion/ fluming are proposed, the impact could be significant due to inhibition of upstream movement to spawn, with potential impacts on future juvenile recruitment.

Impact Assessment

Without mitigation potential impacts from the obstruction of fish passage would be:

- Negative
- Imperceptible (low sensitivity) or significant (Medium to Very High sensitivity sites)
- Significant
- Unlikely (low sensitivity) or possible (sites of at least Medium sensitivity)
- Temporary (lasting less than one year)

<u>Mitigation (by Design)</u>

Within the main wind farm development area, bottomless culverts are proposed at Tributaries 4 and 5 whereas HDPE pipes are proposed at all other access track crossings. The lack of fish and suitable habitat at all watercourses within the main site indicates that mitigation is not required. However, the proposed use of bottomless culverts is supported at any site because they provide greater connectivity throughout a watercourse for the dispersal of all aquatic species including benthic macroinvertebrates, phytoplankton and micro-organisms, all of which are important for ecosystem functioning.

The cable installation for the grid connection will require stream crossings that involve damming and diversion or fluming, or culvert replacement. All temporary culverts should ensure that passage for fish is provided as per IFI guidelines (2016); it is recommended that temporary culverts are embedded at least 300mm below the bed (as proposed above for sites where culvert replacement will occur) to ensure they are back-watered to at least 300mm over their entire length. Any significant change in gradient (e.g. > 3%) should be avoided. Culvert lengths should be as short as possible as longer culverts can be difficult for fish to negotiate.

Similarly, any temporary diversion channels proposed for installation of the cable should avoid creation of a significant gradient and ensure adequate depth to allow fish unimpeded movement.

<u>Mitigation (by Timing of Works)</u>

As per IFI and Loughs Agency guidelines, instream river works should be avoided during the salmonid spawning season and egg incubation phases, 1 October – 30 April.

<u>Mitigation (by fish translocation)</u>

For watercourses with fish species present (and as already indicated above under sediment mitigation measures) the placement of a temporary culvert in a wetted channel, or any requirement to conduct damming and temporary diversion of a watercourse to enable working in dry conditions, will require the translocation of fish prior the commencement of such works.

The fish translocation must be conducted by a fisheries biologist under Section 14 approval from IFI. This mitigation must be conducted in-line with IFI and Loughs Agency permitted times for in-stream works (see above) and should be undertaken immediately prior to proposed in-channel works to prevent fish recolonization of the affected area.

Residual Impacts

With the recommended mitigation measures in place the probability of residual impacts due to temporary obstruction of fish passage will be Unlikely with an impact on the quality of fish, their habitat and aquatic ecology of Neutral.

10.6.4 Operational Phase

Post-construction (operational) effects include habitat loss at watercourse crossings, obstruction of fish passage, and surface water run-off. The potential for any impacts will be significantly reduced during the operational phase with the construction process complete, site infrastructure in place, and a reduced requirement for any hazardous materials on-site. Similarly, the cable connection will be in place and no direct crossing of watercourses will have occurred so that the potential for impacts will be very unlikely.

Habitat loss at stream crossings

A watercourse crossing may result in significant loss of fish habitat if an extensive length of channel is enclosed in a culvert structure, particularly where the original channel bed is lost and cannot be restored. Unnecessary removal of bed materials at stream crossing points can also result in long term loss of habitat, loss of channel diversity and damage to invertebrate food organisms. Enclosure of the channel over significant lengths restricts light penetration which inhibits growth of benthic algae and aquatic plants, in turn leading to reduced potential for macroinvertebrates and fish. This effectively reduces productivity of the channel in the enclosed or shaded section.

This impact has the potential to effect Tributaries 3 and 6-9 where HDPE pipes are proposed. The ecological quality of these tributaries varies from Fair to Moderate but the small area of enclosed stream channel would represent a negligible loss of overall channel habitat with very little expected impact on stream ecosystem productivity.

The cable installation for the grid connection will require replacement of some pre-existing culverts. Where there is potential for the stream to support salmonid fish (e.g. at least Medium sensitivity for trout); as per IFI guidelines (2016), the following mitigations will apply for loss of habitat;

- Clear-span or bottomless culverts are preferred over pipe culverts as they preserve the existing habitat
- Where pipe culverts are approved by IFI, they will be embedded to at least 300mm below the existing bed level (as proposed by TLI in the construction method for any replacement culverts) and filled with clean washed gravels and cobbles to replace lost habitat.

Impact Assessment

Without mitigation, potential impacts on fisheries and aquatic ecology due to loss of habitat would be:

- Negative
- Slight (owing to the small area potentially impacted)
- Likely
- Permanent (the duration of the project life as the culvert will be in place)

Mitigation (by Design)

The design of the wind farm and grid connection route have sought to avoid stream crossings.

Issues relating to watercourse crossings and in-stream works will have been addressed during the construction phase and the proposed mitigation by design will avoid any potential for long term habitat loss during the operational phase. For example, use of bottom-less culverts at several sites will avoid the loss of potentially productive physical habitat such as boulders, cobbles, pebbles. It is expected that channel scour also will wash natural substrata into the HDPE pipes within the wind farm area and also where replacement culverts are required for the cable connection route; this substrate will accumulate on the base and provide some replacement of the habitat lost due to pipe enclosure.

Residual Impacts

With the recommended mitigation measures in place there will be a negligible loss of habitat and the probability of residual impacts will be Unlikely with an impact on the quality of habitat of Neutral.

Fish passage: permanent obstruction/inhibition

The construction of bridges, installation of culverts and other in-channel features can create obstructions to fish passage if the movements of fish are not taken into account at the detailed design stage.

Main Wind Farm area

No tributaries within the turbine and access track area had either habitat suitable for salmonids or fish presence and so no impact is expected.

Impact Assessment

Without mitigation, potential impacts on fisheries and aquatic ecology from the obstruction of fish passage would be:

- Neutral
- No impact

Mitigation (by Design)

The design of the wind farm and grid connection route have sought to avoid stream crossings where possible or use bottom-less culverts. However, while no impact on fish movement is expected because of a lack of fish presence within site tributaries, the use of bottom-less culverts always is preferable to pipes because of the ability to retain the natural stream bed, which provides for efficient in-stream dispersal of all aquatic fauna.

Issues relating to watercourse crossings and in-stream works will have been addressed during the construction phase and the proposed mitigation by design will avoid any potential for long term habitat loss during the operational phase. In addition, the natural accumulation of substrata within pipe inverts over time will provide replacement habitat for that lost due to channel enclosure, facilitating natural recolonization by phytoplankton and benthic macroinvertebrates.

Residual Impacts

With the recommended mitigation measures in place the probability that the proposed development will result in long-term obstruction of fish passage is Unlikely and the residual impacts in this respect will be Neutral.

Cable installation

Mitigation (by Design)

At sites where culvert replacement is proposed along the cable route, IFI guidelines require the following mitigations in salmonid watercourses;

- On watercourses with fisheries interests, clear-span or bottomless culverts are preferred over box/ pipe culverts as they preserve the existing bed, which better facilitates fish movement during high flows or very low water levels.
- Where clear span or bottomless culverts are used, adequate sizing is required to `allow for light penetration, prevention of debris accumulation, and retention of the existing channel profile.
- Box culverts are preferred over round pipe culverts but only where approved by IFI; they will be embedded to at least 300mm below the existing bed level (as proposed by TLI in the construction method for any replacement culverts) to ensure that fish passage is unobstructed
- Where the natural bed is not retained (box/ pipe culverts), material similar or of better quality to the original bed should be placed; clean washed rounded river gravel and cobble are recommended.
- A significant change is gradient (>3%) should be avoided; where gradients will exceed 5%, baffles will be required to break up flow and facilitate fish movement.
- Any bank protection upstream or downstream of the culvert should be conducted so that undercutting or destabilisation of the culvert is avoided.

Residual Impacts

With the recommended mitigation measures in place the probability that the proposed cable installation will result in long-term obstruction of fish passage is Unlikely and the residual impacts in this respect will be Neutral.

Impact Assessment

Without mitigation, potential impacts on fisheries and aquatic ecology due to the obstruction of fish passage would be:

- Negative
- Imperceptible (low sensitivity/ fish absence) or significant (Medium to Very High sensitivity sites)
- Unlikely (low sensitivity) or likely (sites of at least Medium sensitivity)
- Medium to longer term (sites of at least Medium sensitivity)

Surface water run-off and sediment input

Surface water run-off from hard surfaced areas (i.e. access tracks and crane hardstands) during or following periods of heavy rainfall has the potential to cause erosion of constructed drainage routes, existing drainage ditches and gullies leading to run-off of sediments to receiving watercourses with impacts on fish and other forms of aquatic life as outlined above.

<u>Impact Assessment</u>

Without mitigation and depending of the sensitivity of individual watercourses, potential impacts on fisheries and aquatic ecology due to the run-off of suspended solids would be:

- Negative
- Significant
- Likely
- Short-term (one to seven years)

<u>Mitigation (by Design)</u>

Chapter 7: Hydrology, outlines a series of measures to be implemented with regard to the control and attenuation of surface water run-off including a full drainage design that incorporates:

- Stilling ponds to buffer runoff from the drainage system during periods of high rainfall
- Reduction in flow velocity of discharge water by stilling ponds
- Check dams along the drainage route to reduce the velocity of flow thereby preventing channel erosion
- Vegetation filters to receive drainage water from overland flow, will remove suspended sediment
- No direct discharge of development storm water into the existing natural watercourses within the site.

These measures will prevent the run-off of excess sediments to connected rivers, in particular the Stranagoppoge and Stracashel Rivers, via the streams directly draining the site.

Residual Impacts

With the recommended mitigation measures in place the probability of residual impacts from run-off of suspended solids will be Unlikely with an impact on the quality of fish, their habitat and aquatic ecology of Neutral.

10.6.5 Project De-commissioning: Potential Impacts

The decommissioning process will involve the removal of all above ground structures, and reinstatement of disturbed areas following the completion of the wind farms operational lifetime. Some access tracks will be removed and others will remain for farm and forestry use. Overall, the site will return partially to greenfield run-off rates.

Impact Assessment

The impacts of decommissioning are likely to be similar to those of construction although probably of lower magnitude, as it is unlikely that any of the structures at or near to primary watercourses will be removed or modified in any way. For example, culverts/ bridges will remain in place for forestry and farm use.

Without mitigation, potential impacts on fisheries and aquatic ecology due to windfarm and grid line decommissioning will therefore have the potential to be:

- Neutral
- Imperceptible
- Unlikely
- Brief or Temporary

Mitigation

No specific measures required.

Residual Impacts

None.

10.6.6 Trans-frontier Impacts

The location of the proposed development to the international boundary between the Republic of Ireland and Northern Ireland, and the hydrological connection via the River Finn, indicates the potential for trans-frontier impacts. The project is hydrologically linked to both the Foyle and Tributaries SAC and the Lough Foyle SPA in the Republic of Ireland. However, the residual impact after the implementation of the mitigation measures (outlined above) is assessed as negligible and therefore there will be no potential for significant transboundary effects on water quality as a result of the Proposed Development.

10.6.7 Cumulative Impacts

No other existing or proposed developments occur within the locality of the current proposed development, and so there is no potential for significant cumulative effects.

10.6.8 Conclusion

The proposed Graffy wind farm development, including the proposed cable connection route, areas of road widening, and construction of a new access road, is located in the headwaters of two different river catchments (Ownea and Finn), both of which are significant, due to Atlantic salmon stocks and their occurrence within SACs; the Stacashel River also supports a population of FPM. The principal risk to fish and the aquatic environment in general will be during the construction phase of the proposed development.

A series of specific mitigation measures have been designed to address, prevent and mitigate negative impacts on fisheries with regard to construction, operational and decommissioning phases of the project. Implementation of these measures will mitigate any significant effects relating to run-off of suspended sediments, release of pollutants, loss of habitat and obstruction of fish passage, thus ensuring that the overall significance of effects will be Neutral with regard to potential for impact to fish stocks and aquatic ecology of local rivers, in particular the Stracashel/ Owenea, several Stracashel River tributary intersections with the cable route connection, and the Stranagoppoge/ Finn, as the most sensitive receptors.

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10(v) Freshwater Pearl Mussel

RPS Ireland Ltd
April 2021

10(v) Freshwater Pearl Mussel

RPS Ireland Ltd
April 2021

Contents

10.5.1 Introduction

10.5.1.1 Description of Development

The proposed Graffy Wind Farm is located in an area that drains to two separate river catchments; the Stracashel River sub-catchment of the Owenea River, which flows to the west, the Stranagoppoge River sub-catchment of the River Finn, which flows to the east.

The proposed development will comprise 8 wind turbines and a 7.5km connection cable from a proposed substation at Meenagrubby to ESB Tievebrack station at Drumnalough. Infrastructure within the wind farm landholdings will include construction of new access tracks, a temporary contractors' compound area, a substation, on site drainage management works, spoil disposal areas, underground electrical cables, junctions and turning areas, turbine bases, foundations, turbine hardstands and temporary set-down areas. The cable connecting the proposed wind farm to the Tievebrack station will be installed directly within the existing road infrastructure and will cross above or below watercourse culverts/ bridges. In addition, several areas of the development will involve upgrading of the transport route via widening and the creation of a new short access road through existing Coillte lands.

10.5.1.2 Statement of Authority

RPS is the leader in a wide range of disciplines on an all-island basis. We specialise in the project management, planning, design, environmental studies, statutory processes, procurement and contract supervision of major infrastructural projects in the public and private sectors. Senior Associate Director, Mark Magee holds a BA (Mod) in Natural Sciences and an MSc in Environmental Engineering. He is a chartered environmentalist, chartered scientist and chartered water and environmental manager with 22 years' experience in aquatic ecology, catchment management and river basin planning, environmental assessment, appropriate assessment, environmental appraisal of infrastructure projects, hydrology, hydraulic modelling and water quality assessment.

Mark was also involved Freshwater Pearl Mussel Sub-Basin Management Plans for 27 SAC catchments on behalf of the DECLG and NPWS respectively under the NS2 project and was assistant project manager on the INTERREG IVA Freshwater Pearl Mussel Project producing sub basin management strategies for the Northern Ireland FPM catchments and trialling measures for FPM protection in the River Leannan and Glaskeelan River catchments in Co Donegal. Mark is currently working on a number of catchment based initiatives including the development of conservation management plans for 7 aquatic SACs in Northern Ireland for NIEA, including the Owenkillew River SAC which includes FPM as a qualifying feature.

10.5.2 Scope and Purpose

This chapter assesses the effects of the proposed wind farm on freshwater pearl mussel (*Margaritifera margaritifera*) and associated habitats in the downstream watercourses hydrologically connected to the site.

The freshwater pearl mussel, *Margaritifera margaritifera*, is widespread in Ireland in rivers of low pH, but most populations have experienced a decline in recent years (Moorkens, 1999; Moorkens & Costello, 1994, Moorkens et al., 2007). Deterioration in river bed and river water quality has resulted in the majority of mussel populations failing to recruit young mussels over the last 30 year period, and widespread extinction of mussel populations is predicted. The species is listed as "critically endangered" in the IUCN international red data book (Moorkens, 2011). Pearl mussels are a protected species, both in Irish law under the Wildlife Act, and under the European Union Habitats Directive, where it is listed in Annex II and V. The effect of these legislative provisions is to give protection to both the animal and its habitat.

The freshwater pearl mussel is currently failing to meet the objectives of the Habitats Directive and is at unfavourable conservation status in Ireland. The cause of this failure is deterioration in the status of the water bodies which support the species together with a deterioration in their habitat. The European Communities Environmental Objectives (Surface Waters) Regulations, S.I. 272 of 2009, require the Environmental Protection Agency to assign a status of 'less than good' to surface water bodies in protected areas that fail to meet the water quality or hydrological standards necessary for their protected area objectives. Where bodies of surface water or groundwater fail to achieve good status, the WFD and transposing legislation require the relevant public authorities to take actions to restore them.

The proposed development is located within the Owenea Freshwater Pearl Mussel catchment. The Freshwater Pearl Mussel Regulations (European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations, S.I. 296 of 2009) require that there is no artificially elevated levels of sedimentation present at the pearl mussel habitat. The requirements of the Freshwater Pearl Mussel are more stringent than for other freshwater species and therefore every possible effort is required to minimize the impact on both the habitat and the species itself. The freshwater pearl mussel population in the Owenea River, County Donegal, is a named feature of the West of Ardara/Maas Road Special Area of Conservation (Site Code 0197). As part of the ongoing protection of the population, a sub-basin management plan is required. A draft plan has been published (Anon., 2010). The draft plan states that the habitat of the Owenea river bed is in poor condition and that the population is in unfavourable status. This status needs to be improved for the mussel population to survive.

The principal consultees during the study were National Parks and Wildlife Service who were consulted with regard to previous records of the FPM in the Owenea catchment and conditions assessment undertaken in accordance with Article 11 of the habitats Directive and the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations, S.I. No. 296 of 2009 through a sensitive data request. Given that salmonids are a key part of the FPM life cycle, acting as the host species for the larval stage the IFI were also consulted to scope of the assessment and to provide data on fish stocks in relevant watercourses. Details of the IFI response is provided in Chapter 10(iv) and included reference to the importance of the Owenea River in maintaining populations of endangered Freshwater Pearl Mussel (FPM), together with the importance that juvenile salmonids play in the life-cycle of the mussels. The potential impact of sediment on FPM was highlighted.

10.5.3 Description of the Study Area

The study area focused on the watercourses draining the proposed site / planning application boundary, which are small tributaries of either the Stracashel River (Owenea) or Stranagoppoge River (Finn) and the downstream hydrologically connected water bodies where there are known records of FPM. In order to inform the extent of the study area the field work carried out for the previous Environmental Impact Statement (EIS) prepared for the Graffy Windfarm was reviewed to establish whether the habitat of the small tributaries were capable of sustaining FPM populations. This was supplemented by a review of the suitable habitat length for FPM published in the Conservation Objectives document for the West of Maas/Ardara Road SAC (NPWS, 2015) and a sensitive data request from NPWS for records in the Owenea FPM catchment.

As outlined in the fisheries and aquatic ecology section there are ten small water courses that drain the main windfarm development, none of which have suitable habitat for FPM due to gradient and the physical habitat within the channel. There are a further 18 water courses traversed by the cable route for the grid connection to Tievebrack substation, however these water courses are not suitable for FPM due to physical habitat, water depth and gradient. There are a further 12 water courses traversed by the new access road through the Coillte lands and the local road that requires widening to allow access to the windfarm development. These are mainly of low ecological value and are not capable of sustaining FPM populations. Whilst these water courses are not capable of sustain FPM population they provide a hydrological link to the sensitive downstream water courses that have viable populations of FPM, i.e. Stracashel River and the Owenea River and are therefore capable of carry fine sediment and other pollutants to the FOM habitat reaches.

Figure 10.5.1 indicates where the suitable habitat reaches from freshwater pearl mussel are located as indicated in the Conservation Objectives document for the West of Ardara/Maas Road SAC (NPWS, 2015). The Owenea catchment is also illustrated on this mapping as are the SAC boundaries and footprint of the development. The locations of the FPM surveys undertaken for this planning application and the previous planning application are not illustrated on this map but are included in Figure 10.5.2, Appendix 10.5.1 with the detailed results of the field work. However *Margaritifera* monitoring and survey reports contain precise and accurate data on the location and abundance of the species. Exploitation of *Margaritifera margaritifera* (pearl-fishing) is an on-going risk and leads to mussel death and damage to the species' habitat. In consequence, the survey results are considered highly sensitive and should not be released to the public. Therefore this section of the EIAR is redacted and is not available to the public as it is classed as confidential due to the sensitive information contained therein.

10.5.3.1 Owenea Catchment

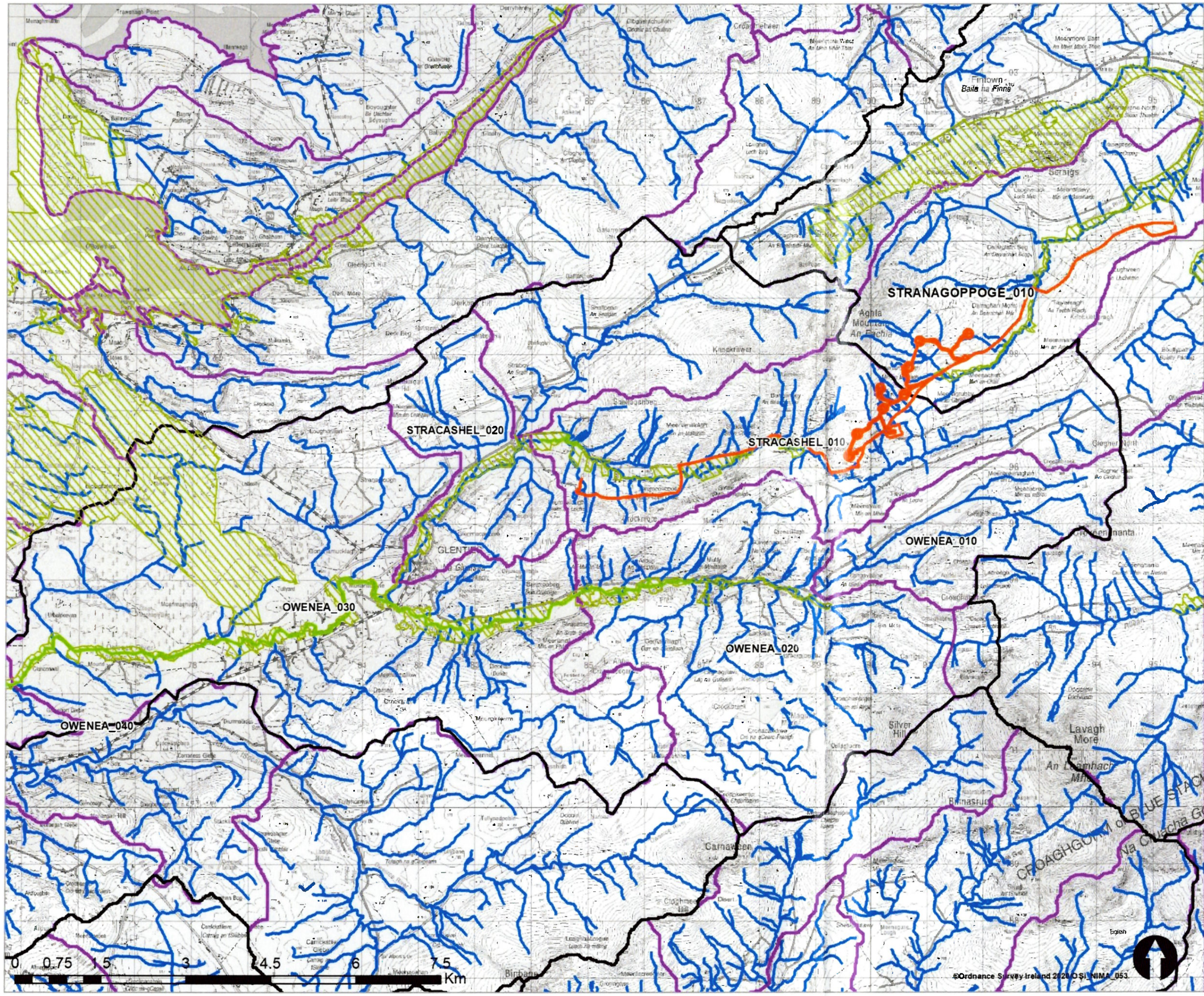
The previous field work for the now expired planning permission for the Graffy Wind Farm was undertaken at 19 separate locations and did not find any mussels outside of the Owenea main channel. The upper reaches of the Owenea, upstream of the confluence with the Stracashel River does have previous records of FPM populations and the previous surveys for this proposed development did note population in a scatter abundance <50 per 100 metres, however as the proposed development will not impact this reach directly or indirectly, it has not been considered in this updated assessment. The FPM surveys in the Owenea are therefore focussed downstream of the confluence with the Stracashel River due to the hydrological pathways to the proposed windfarm development.

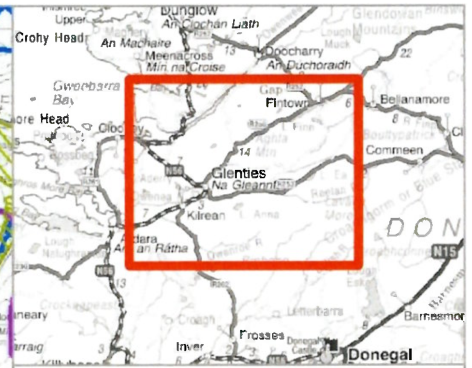
10.5.3.2 Stracashel Catchment

There are previous FPM records in the Stracashel River downstream of the proposed wind park development as indicated in the conservation objectives document for the West of Ardara to Maas Road SAC, see Figure 10.5.1. These reaches are the closest to the windfarm development and were the focus of the FPM surveys undertaken as part of this assessment. As outlined above the water courses within the windfarm development draining to the Stracashel River and the tributaries crossed by the cable route do not contain suitable FPM habitat, but do provide a hydrological link to the downstream sensitive areas.

10.5.3.3 Finn Catchment

Historically there are records of FPM in the River Finn based on the NPWS FPM sensitivity mapping, which indicates that the Finn catchment has extant populations of FPM. Although FPM are cited as present in the River Finn catchment from historical records, an extensive survey by Beasley and Roberts (1999) did not find any despite the sites having similar physico-chemistry and habitat suitability as rivers in which the species was present. FPM is not a qualifying feature of the River Finn SAC but historical records of the FPM have been noted downstream of the Stranagoppoge River confluence. The previous field work undertaken confirmed that the small streams draining from the windfarm site to the Stranagoppoge River are on steep gradients and do not have suitable FPM habitat, however they are capable of carrying sediment and other pollutants.





Legend
- NPWS - FPM Habitat Classification Reaches
- Windfarm Red Line Boundary
- SAC
- FPM Catchments
- River Sub Basins
- River Waterbodies

rev	ammendments	drawn	date

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CLIENT
Cuilfeach Teoranta

PROJECT
Graffy Wind Park

TITLE
Figure 10.5.1 Site location in context of freshwater pearl mussel habitat, river water bodies and SAC

Project Number	Sheet Size	Drawing Scale
IBE1760	A3	1:65000

Drawing Number	Datum
IBE1760/ENV/CONS/BT/1001 - 1010	–

Drawn by	Status	Revision
FMcC	S?	–

Checked By	Approved By	Date
MM	MM	07/05/2021

10.5.4 Policy and Guidelines

10.5.4.1 International Union for Conservation of Nature

Freshwater pearl mussel (*Margaritifera margaritifera L.*) populations are under serious threat of extinction throughout their geographical range and only a few remnant populations are recruiting to adulthood. Consequently, *M. margaritifera* is classified as endangered on the International Union for Conservation of Nature Red List.

10.5.4.2 Habitats Directive (92/43/EEC)

The Habitats Directive provides legal protection for habitats and species of European importance. The main aim of the Habitats Directive is "to contribute towards ensuring biodiversity through the conservation of natural habitats of wild fauna and flora in the European territory of the Member States to which the treaty applies" (92/43/EEC).

The Directive requires the establishment and conservation of a network of sites known as Natura 2000 (Article 3). Article 4 of the Directive provides for the creation of protected sites known as Special Areas of Conservation (SACs) for a number of habitat types and certain species of flora and fauna, e.g. the freshwater pearl mussel. SACs together with Special Protection Areas (SPAs) designated under the Birds Directive (Council Directive 79/409 EEC) form the Natura 2000 network.

The Habitats Directive requires that Special Areas of Conservation (SAC) be designated to protect listed natural habitats and species of Community interest, and that measures taken pursuant to the directive must be designed to maintain or restore certain habitats and species 'at favourable conservation status.' Annex II of the Habitats Directive lists the species of Community interest and includes the water-dependent freshwater pearl mussel (*Margaritifera margaritifera* and *M. durrovensis*).

Article 6 outlines the provisions by which the conservation and management of Natura 2000 sites will be implemented. This is seen as one of the most important articles of the Directive, as it governs the interaction between conservation and land-use. In the context of the freshwater pearl mussel it is critical to the measures that must be taken to restore or maintain 'favourable conservation status of the SAC populations.

Annex V includes species which require protection due to exploitation by human beings. It is often the case that species may be subject to numerous threats and therefore can fall within a number of the annexes listed above. In the case of FPM, the species is listed under Annex II and Annex V and therefore is afforded protection through the designation of sites to ensure the protection, maintenance and restoration of its habitat, i.e. Special Areas of Conservation (SAC), but also through the prevention of human exploitation (pearl fishing).

10.5.4.3 Freshwater Pearl Mussel Regulations 2009 (S.I. No. 296 of 2009)

Under Article 6 of the Habitats Directive as mentioned above, Member States must show the steps taken to achieve the Directives objectives as well as avoiding deterioration in those natural habitats and habitats of Annex II species. To achieve these requirements, in Ireland the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (S.I. No. 296) have been established.

The Regulations support the development and implementation of the 27 Freshwater Pearl Mussel Sub Basin Management Plans (SBMP) and the achievement of favourable conservation status for the pearl mussel in the Republic of Ireland. The Regulations

(a) Set environmental quality objectives for the habitats of the freshwater pearl mussel populations named in the First Schedule to these Regulations that are within the boundaries of a site notified in a candidate list of European sites, or designated as a Special Area of Conservation, under the European Communities (Natural Habitats) Regulations, 1997 (S.I. No. 94/1997).
(b) Require the production of sub-basin management plans with programmes of measures to achieve these objectives.
(c) Set out the duties of public authorities in respect of the sub-basin management plans and programmes of measures.

10.5.4.4 European Communities (Natural Habitats) regulations S.I. 94 of 1997 as amended in 1998 and 2005

In 1997, the Habitats Directive was transposed into Irish national law. The relevant Regulations European Union (Natural Habitats) Regulations, SI 94/1997, represented a fundamental shift in nature conservation policy and law. These Regulations have since been amended by SI 233/1998 & SI 378/2005 Communities (Natural Habitats) (Amendment) Regulations, 2005.doc). The aim of the regulations is:

'to contribute towards ensuring bio-diversity through the conservation of natural habitats and of wild fauna and flora.'

10.5.4.5 The Wildlife Act (1976), The Wildlife (Amendment) Act, 2000

The Wildlife Act, 1976 and the Wildlife Amendment Act, 2000 are the principal statutory provisions providing for the protection of Wildlife (both Flora and Fauna) and the control of activities which may impact adversely on the conservation of Wildlife.

The Wildlife Act, 1976 (Protection of Wild Animals) Regulations, 1990 (SI No. 112, 1990) conferred protected faunal species status for *M. margaritifera* under the fifth schedule of the Wildlife Act (1976), and other subsequent protections under the Wildlife (Amendment) Act 2000. As it is an offence to injure or wilfully interfere with or destroy the breeding place or resting place of a protected wild animal, Freshwater Pearl Mussel is protected under Section 23 of the Wildlife Act as amended. Currently all bird species, 22 other animal species or groups of species and 86 species of flora are afforded protected status.

10.5.5 Assessment Methodology

10.5.5.1 Desk Top Study

A desk study was carried out to determine baseline information relating to FPM through a sensitive data request to the NPWS, for records and reports on the FPM populations in the Owenea and Stracashel catchments. The following sources from the NPWS were consulted/used:

- NPWS FPM Habitat Classification (version 11)
- NPWS Margaritifera records (version 16)
- NPWS Magaritifera Sensitive Areas Map
- Survey and Condition Assessment of the Population of the freshwater pearl mussel *Margaritifera margaritifera* in the Owenea River County Donegal (Moorkens, 2017)
- Margaritifera Monitoring Report (Moorkens 2009)
- Rapid Assessment of Rivers with Prior Records of *Margaritifera margaritifera* (Moorkens, 2007)

In addition the FPM survey undertaken for the previous planning application was also consulted.

These reports all contain highly sensitive information regarding a protected species that is vulnerable to damage by members of the public, therefore specific information on the locations of pearl mussels is not disclosed in the section below on the existing environment, but rather reference is made to the location of the reaches of the Stracashel and Owenea River that have FPM habitat.

10.5.5.2 Freshwater pearl Mussel Survey Methodology

Survey of adult Margaritifera is carried out with the animals in situ i.e. it is not permitted to remove live animals from where they are found. In order to minimise potential damage caused to mussels by survey and to make comparison between survey results at different times and at different locations possible, a standard survey methodology has been developed, based on best practice and reliability (Anon., 2004).

Those licensed to carry out Margaritifera survey work in Ireland are expected to use the standard methodology. For this survey, a standard Stage 1 survey was carried out on locations on the Stracashel and Owenea Rivers. This is a presence/absence survey based on a search of those sections of the river exhibiting features most likely to support pearl mussels. In shallow streams, such as those within the study area, this was undertaken by wading with a bathiscope or "glass-bottomed" bucket.

As outlined in Section 10.5.3 above the survey reaches were selected based on the finding of the previous FPM survey undertaken for the previous planning application for the Graffy Wind Farm in July 2009.

The FPM habitat in the Stracashel occurs downstream of the Tievebrack sub-station and therefore downstream of the proposed development. The main population of the pearl mussels in the Owenea River is known to occur in the lower end of the river downstream of the Stracashel River confluences, therefore the purpose of the targeted survey was to assess how close to the Graffy Windfarm the freshwater pearl mussels occur.

In order to protect the freshwater pearl mussel, any action that might have an adverse effect upon the mussel can only be carried out under license. This includes mussel survey work (or any other form of research on mussels), as this has the potential to cause damage to the mussels. This survey was carried out under License Number C229/2019 on the 4th October 2019 and License Number C230/2020 on 6th February.

A report on the FPM surveys undertaken as part of this assessment is included in Appendix 10.5.1, however this section of the EIAR is redacted as it is classed as confidential due to the sensitive information contained therein.

10.5.5.3 Method for assessing significance of impacts

An assessment has then been made of the project to determine the likelihood of significant impacts on FPM habitat including water quality and substrate condition using criteria for rating significance and magnitude set out in the generic methodology for environmental sensitivity outlined in the Design Manual for Roads and Bridges (DMRB) (2011). The significance of impact on FPM Habitat including, water quality substrate and flows, likely to occur during the construction and operation phases of the development are determined using a predominantly qualitative methodology supported where appropriate, by quantitative assessment. The assessment is a consideration of a combination of receptor sensitivity (**Table 10.5.1**) and the potential magnitude of the impact on the water environment (**Table 10.5.2**), in order to determine significance (**Table 10.5.3**).

The approach to assessing the significance of impacts comprises assigning each impact to one of the four categories of magnitude as outlined in **Table 10.5.2** to enable different characteristics to be assessed based upon the same scale.

The significance determination and assessment of the potential likely environmental effects of each component of the project has been made based on the matrix presented in **Table 10.5.3.**

To conclude the assessment, mitigation measures are proposed to reduce, avoid and prevent these likely significant effects, where appropriate. This enables a "with mitigation" assessment to be made of any residual impact as a result of the construction and operational phases of the project and/or in combination with other existing or approved projects.

Table 10.5.1: Criteria for Rating Receptor Sensitivity

Value (Sensitivity)	Typical Descriptors
Extremely High	***Attribute has a high quality or value on an international scale.*** Examples: Examples: River, Wetland or surface water body ecosystem protected by EU legislation. i.e. designated under the Habitats, Birds, Shellfish, Bathing Water or Freshwater Fish, Drinking Water or Nitrate Directives.
Very High	***Attribute has a high quality or value on a regional or national scale.*** Examples: River, Wetland or surface water body ecosystem protected by national legislation (NHA status), Regional important potable water source supplying >2500 homes, nationally important amenity site for wide range of leisure activities, Quality Class A (Biotic Index Q4, Q5), Flood plain protecting more than 50 residential or commercial properties from flooding.
High	***Attribute has a high quality or value on a local scale.*** Examples: Salmon fishery, locally important potable water source supplying >1000 homes, Quality Class B (Biotic Index Q3-4), Flood plain protecting 5 to 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.*** Examples: 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.*** Examples: Locally important amenity site for small range of leisure activities, Local potable water source supplying <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 10.5.2: Criteria for Rating the Magnitude of Impact

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute and /or quality and integrity of attribute	Loss or extensive change to a water body or water dependent habitat.
		Increase in predicted peak flood level >100mm.
		Extensive loss of fishery
		Extensive reduction in amenity value
		Potential high risk of pollution to water body from run-off
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Increase in predicted peak flood level >50mm
		Partial loss of fishery
		Potential medium risk of pollution to water body from routine run-off
		Partial reduction in amenity value
Minor Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Increase in predicted peak flood level >10mm
		Minor loss of fishery
		Potential low risk of pollution to water body from routine run-off
		Slight reduction in amenity value
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Negligible change in predicted peak flood level Negligible loss of amenity value Negligible loss of fishery

Table 10.5.3: Criteria for Rating the Significance of Environmental Impacts

Importance of Attribute	Magnitude of Impact			
	Negligible	Minor	Moderate	Large
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant / Moderate	Profound / Significant	Profound
High	Imperceptible	Moderate / Slight	Significant / Moderate	Severe / Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight / Moderate

10.5.6 Baseline Conditions

10.5.6.1 Stracashel and Owenea Rivers

A number of small tributary streams of the Stracashel River drain the west-south-west portion of the proposed Graffy Wind Farm. The Stracashel River is the main tributary of the Owenea River, draining west for approximately 17km before meeting the Owenea south-west of Glenties (Figure 10.5.1). The Owenea River lies parallel and south of the Stracashel where it drains west of Lough Ea for over 20km before entering Loughros More Bay near Ardara.

10.5.6.2 Stranagoppoge and Finn Rivers

Several small tributaries of the Stranagoppoge River drain the east-north-east portion of the proposed wind farm site. The main Stranagoppoge River flows for approximately 8km before meeting the main River Finn approximately 4km downstream of Lough Finn (Figure 10.5.1). The Finn flows for over 50km before joining the River Foyle at Lifford.

10.5.6.3 Designated sites

While there are no designations in the immediate wind farm development site relating to water dependent habitats or species, a number of designated sites, hydrologically linked to the proposed development through connecting watercourses, are present, while the extreme east and west sides of the development intersect SACs.

River Finn SAC

The southern boundary of the site development and associated drainage streams are located immediately above the upstream boundary of the River Finn SAC (IE002301) on the Stranagoppoge River; the eastern end where upgrading of the road for transport is proposed, intersects the Upper Stranagoppoge River SAC, while a number of small undesignated watercourses drain to the SAC. The designated site extends downstream to the River Finn confluence and along its entire length to Lough Foyle. This SAC is not designated for FPM.

West of Ardara/ Maas Road SAC

A portion of the boundary of the West of Ardara/ Maas Road SAC (IE000197) extends upstream along the Stracashel River, between 2 and 3 km downstream of the small watercourses draining the south-western portion of the immediate wind turbine boundary (Figure 10.5.1). However, the area beneath and immediately downstream of the proposed cable crossing of the Stracashel is within the SAC where the following aspects are relevant to freshwater pearl mussel;

- The SAC is designated in the Republic of Ireland, with Atlantic salmon, Freshwater Pearl Mussel (FPM), European Otter, noted as Annex II species selected as the primary reason for the designation of the site and occurring within the Stracashel and Owenea rivers.
- Oligotrophic water containing few minerals, estuaries, and tidal mudflats and sand flats also are Annex I habitats that have been selected as primary features of the designation.

Foyle and Tributaries SAC/ ASSI

Although the site is located 50km upstream of the River Foyle and Tributaries SAC and ASSI, the lower River Finn is bisected by the international border and several kilometres of the Finn are within the SAC/ASSI in Northern Ireland. The following aspects of the SAC/ ASSI are relevant to freshwater pearl mussel;

- River Foyle and Tributaries SAC – The river habitat is a key selection feature with a global assessment grade of "B" International Importance, due to the presence of dynamic flow habitat types, largely natural channel and substrates, and extensive beds of water crowfoot *Ranunculus* in stretches including the Strule. Annexe II listed Atlantic salmon is as a primary selection feature of the designation with a global assessment grade of "B" – International Importance (NIEA, 2015). Annex II listed European Otter, *Lutra lutra*, is also a qualifying feature with a global assessment grade of "C" – National Interest, but is not the primary reason for the designation. Sea Lamprey, River Lamprey, Brook Lamprey and Pearl Mussel are included as selection features of interest (global assessment grade D) but are not qualifying features for the designation (NIEA, 2015).

- River Foyle and Tributaries Area of Special Scientific Interest (ASSI) – The River Foyle and Tributaries was designated as an ASSI in 2003 under Article 28 of the Environment (Northern Ireland) Order 2002, with the designated area corresponding to that of the SAC. The ASSI designation is largely on account of the rivers naturalness of channel and bank, and because of the presence of Atlantic salmon (see below) and European otter. It is not designated for freshwater pearl mussel.

10.5.6.4 Existing Information on FPM in the study area

FPM are distributed in the Owenea catchment in both the Owenea and Stracashel Rivers and are a key site feature of the West of Ardara/ Maas Road SAC designation. In a 2009 survey for the previous Graffy Wind Farm planning application, Moorkens (2009) reported an absence of mussels in the sites surveyed for the Stracashel River and associated tributaries, but reported mussels in the main Owenea River downstream.

A series of surveys from 1988 to 2007 have shown a continual decline in Owenea FPM populations leading to a status assessment of "Unfavourable"; loss of habitat, siltation, and nutrient enrichment were cited as key causes of the mussel population's poor status. As a result of the current status of FPM, and in line with RBMPs, the Owenea River Sub-Basin Management Plan was published to provide a programme of measures to assist in the attainment of "Favourable" conservation status for the FPM population.

The most recent condition assessment undertaken in 2016 on behalf of the NPWS (Moorkens, 2017) concluded that the Owenea *Margaritifera* population is continuing to decline in the sections that were monitoring, i.e. at the lower reaches of the Owenea River. The survey noted that there are a few areas of preferential flow where nutrient enrichment was less obvious but most of the river bed is either too scoured to support mussels or too low in velocity with siltation damage and excessive growth. The condition report noted that even in the areas of good habitat, juveniles and young mussels were absent, but that the adults tested were not stressed and the oxygen levels in these areas of best habitat were adequate, suggesting in the long term that the damage to some areas may be reversible.

Although FPM are cited as present in the River Finn catchment from historical records, an extensive survey by Beasley and Roberts (1999) did not find any despite the sites having similar physico-chemistry and habitat suitability as rivers in which the species was present. In 2009, Moorkens (2009) surveyed the Stranagoppoge River tributary of the Finn for FPM and did not report any presence at sites downstream of where the current development is proposed.

10.5.6.5 Field Survey

The field survey for pearl mussels focused on those sites from the previous survey that identified mussels where present and also the FPM habitat reaches identified in the Conservation Objectives document for the West of Ardara/Maas Road SAC (NPWS, 2015). The 2009 survey undertaken for the previous planning permission (Moorkens, 2009) looked at 19 sites in the Owenea, Stracashel and Stranagoppoge Rivers and based on that survey no mussels were found outside of the Owenea main channel, however more recently the FPM habitat reaches have included one stretch along the Stracashel River downstream of the Tievebrack substation.

A total of four reaches were surveyed, which corresponded to the published reaches of FPM habitat in the Stracashel and Owenea Rivers as identified in Figure 10.5.1. The details of the survey results and mapping of the location of the surveyed reaches are included as a confidential appendix (Appendix 10.5.1). A summary of the results are provided below.

Stracashel River

Two 100 metre sections of the Stracashel River were surveyed downstream of the Tievebrack substation. A total of 109 adult mussels were recorded across these two sections however the condition of the habitat was poor with substrate heavily silted and bank collapse and undercutting noted.

Owenea River

The Owenea River was surveyed in three locations downstream of the confluence with the Stracashel River.

The first reach closest to the confluence at Mulantiboyle recorded no evidence of mussels and the condition of the habitat was of poor quality, which is consistent with the previous survey undertaken for the windfarm in 2009.

The next area downstream in the Townland of Kilraine a total of 30 live adult mussels and 5 dead shells where recorded. This corresponded to the location previously surveyed in 2009 as part of the previous planning application for the Graffy Windfarm. The numbers of mussels recorded were similar, the habitat was representative of a good mix of clast sizes and good stable FPM habitat. However it was heavily silted and in poor condition.

The furthermost section downstream of the confluence with the Stracashel was located at Clommacwal and the distribution of pearl mussels along this section was recorded as common to good, i.e. 301-1500 individuals per 100 metres. However the condition of substrate was again heavily silted with significant bank slump recorded along the right hand bank looking downstream

10.5.7 Assessment of Impacts

The key cause of decline to this pearl mussel population has been the loss of juvenile mussel habitat, and thus the slow decline of the population through lack of replacement of older mussels with younger ones as the older ones die off.

The conservation objective for the freshwater pearl mussel in the West of Ardara/Maas Road SAC [000197] is to restore the favourable conservation condition of the species. The condition of the habitat is critical to this objective and can be affected indirectly by the proposed Graffy Wind Park development.

The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Owenea system. The reach of the river surveys for this proposal has suitable habitat. However it is in unfavourable condition, largely due to the infiltration of fine sediment in the substrate and the flow conditions along this reach.

The key issue with assessment of potential risks to the Owenea pearl mussel population from the proposed windfarm development is management of silt, flow regime and other pollutants.

If the construction of the development was to result in the release of silt or pollutants into the water courses draining the site, which provide a hydrological pathway to the nearest FPM habitat 2.3 km downstream, there would be a negative impact on the pearl mussel population.

The draft sub-basin management plan for the Owenea FPM catchment is proposing measures to reduce the current siltation problems to levels that are compatible with a functioning, reproducing pearl mussel population. Therefore new sources of siltation would be contrary to the improvements that would be conferred by measures taken in the sub-basin plan. Details of the significant impacts are provided below.

10.5.7.1 Sensitivity of water courses

Based on the criteria identified in Table 10.5.1 the sensitivity of the receiving water courses in the context of freshwater pearl mussel are listed in Table 10.5.6 below

Table 10.5.6: Receptor Sensitivity

Watercourse	Key Species/ receptors	Ecological quality	Sensitivity
Sensitive downstream watercourses			
Stranagoppoge River	No evidence of freshwater pearl mussel, however SAC & salmon present; trout present; Q-value 4; ASPT 6.75.	**Good**	**Very High**
River Finn	River Finn is classified as a catchment with extant freshwater pearl mussel populations however they are not qualifying features of the River Finn SAC and extensive surveys in 1999 did not identify any remaining populations. Salmon present; trout present.	**High**	**Very High**
Stracashel River (downstream of Tievebrack substation)	SAC, freshwater pearl mussel present; Q-value 4-5;	**High**	**Extremely High**
Owenea River (downstream of confluence with Stracashel River	SAC, freshwater pearl mussel present; & salmon; WFD status Good; trout present;	**Good**	**Extremely High**

10.5.7.2 Construction phase

Peat Slippage Risk

A detailed peat slippage risk assessment was undertaken and is reported in Section 6.4.4 of the Soils, Geology and Hydrogeology chapter. This chapter also reviews the most recent construction-related peat landslide, which occurred during the construction of the Meenbog Wind Farm, County Donegal on 12 November 2020 and concludes that *"The ground conditions found at the Meenbog Wind Farm peat slippage site do not occur within or near the development footprint of the Graffy Wind Farm site"*.

The overall conclusion of the peat slippage risk assessment is that *"a peat landslide occurring is unlikely and the indicative risk level is negligible. A comprehensive set of avoidance, reduction and mitigation measures are proposed as set out in Section 6.5. This includes* *avoidance of conditions that triggered peat slippage at Meenbog, namely the loading of weak peat by use of floating roads or stockpiling of excavated material."*

On this basis the risk of peat slippage and potential to impact on the FPM is not significant, however the potential for sediment run-off is a potentially significant effect as outlined below.

Sediment run-off

Increases in sediment movement through rivers and its settlement onto the river bed cause formerly clean gravels to become clogged with fine sediment. This prevents oxygen movement into the interstitial waters in the river bed that feed the juvenile mussels, and they quickly die. Each time siltation of FPM habitat occurs, all juvenile mussels below five years of age are killed, and therefore a very low level of silt entering the river is essential on an ongoing basis. The survey conducted under this project established that the habitat is heavily silted with silt plumes evident on disturbance of the river substrate and bank erosion exacerbating fine peaty sediment in the habitat.

Sediment run-off could result from:

- Excavations associated with construction of access tracks and turbine foundations
- Surface peat disturbance and subsequent erosion of the underlying soils
- Stockpiling of soils and excavated materials
- Much of the natural drainage at each turbine location will be by direct run-off and when the ground is saturated a high percentage of the rainfall will run off quickly to receiving watercourses generating the potential for significant sediment loading to these water courses
- Run-off from access tracks
- Erosion of sediment from constructed drainage channels
- Excavations associated with installation of culverts for watercourse crossings
- The installation of the connecting cable between the Wind Farm substation and the Tievebrack Station which will follow the public road before crossing the main Stracashel River, upstream of where freshwater pearl mussel populations are, after which it will follow a forestry track to the main station.

The main risk to the receiving environment will therefore be during and following periods of heavy and sustained rainfall; such events are more likely during the autumn/winter period. There is a direct hydrological connection between the proposed site and the Stranagoppoge, Stracashel and Owenea Rivers, the latter two important for freshwater pearl mussel and therefore considered to be extremely sensitive, and therefore a potential route for suspended solids to reach key areas of the river.

As with siltation, nutrient enrichment can have serious and ongoing impacts on juvenile mussels. Increased inputs of dissolved nutrients to pearl mussel rivers tend to lead to filamentous algal and macrophyte growth, which can decay to form organic silt. The percentage cover for filamentous algae and macrophytes as required under the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (S.I. No. 296/2009) is no more than 5%, however the survey conducted for this project noted that there was at least 10% coverage of both filamentous algae and macrophytes recorded, despite the survey being conditioned in late October. The disturbance of soils during the construction could release sediment bound nutrient to the aquatic environment and therefore the control of run off from the proposed construction areas will also reduce the risk from nutrient export for the works area.

The construction of the Wind Farm is estimated at 12 months with most earth works conducted between 6-8 months. Given the scale and nature of the works, the magnitude of the impact associated with sediment loading is considered to be large adverse. The significance of the environmental effect is therefore profound in the absence of mitigation based on the extremely high sensitivity of the receiving environment.

Oils and other Chemicals

Construction of the proposed development will involve the use of plant and machinery as well as the associated temporary storage of construction materials, oils, fuels and chemicals in designated areas within the application site. There is the potential for spillage or release of fuel oil and other dangerous substances, which could impact on the surface and ground water bodies associated with the application site. It is also possible that small residue amounts left on site may be mobilised by surface run-off and washed into the watercourses.

The use of cement and concrete in the construction of the foundations, culverts or hard-standing areas at the substation and associated infrastructure has the potential to impact upon water quality and FPM habitat downstream. Fresh concrete and cement is highly alkaline and therefore is likely to affect the supporting conditions for FPM, if washed into the watercourses directly affected by the proposed development and ultimately the Stracashel and Owenea Rivers and associated FPM habitat by indirect hydrological link.

Given the scale of the proposed development and assuming the potential for minor to major spillage occurrences the magnitude of the impact is considered to be large adverse and with the sensitivity of the receiving environment assessed to be extremely high the significance of the environmental impact is potentially profound for freshwater pearl mussel resulting in possible mortalities to the downstream populations.

Watercourse Crossings

Several methods will be used to deploy the cable at a watercourse crossing depending on individual site conditions (as per TLI Construction Methodology, Attachment 7, CEMP) which all have the potential to introduce fine sediment to the receiving environment:

- Cutting and filling of open trench within the existing road above the watercourse: - i.e. above a culvert/ bridge. There is limited potential for significant run-off as the cable is installed in the road footprint and works predominantly contained within the road.
- Where insufficient headroom is available above a culvert or the deck of the road bridge the intention is to come "off-line" and install the cable as follows;
  - Below watercourse via an open trench in dry conditions after damming and diversion of water over or around the works. If not installed correctly this represents a significant risk of sedimentation in the receiving water courses and indirectly to the freshwater pearl mussel habitat downstream
  - Trenchless beneath the riverbed by Horizontal Directional Drilling (HDD); - HDD is a trenchless crossing method that uses a steerable method of installing the cable in an arc along a prescribed bore path under the riverbed using a surface-launched drilling rig. Drilling is assisted by pumped pressurised drilling fluids, comprising a mixture of freshwater and a bentonite clay-based lubricant. HDD may result in the escape to the watercourse of pressurised drilling fluids (bentonite/ mud) through rupture or "break-out" of the underlying bed material and movement beyond the base of the structure or from surface run-off caused by drilling fluid returns at entry and exit points. Although drilling mud escapes will have similar impacts on aquatic biota and habitats as described for fine sediment above, deposition rates of drilling mud are likely to far exceed background levels owing to the density of the fluids, and may have greater magnitude of impacts because of the much finer material released and its greater

potential infiltration of the riverbed. The additives in bentonite clay may also cause toxicity; for example, added starches can have very high biochemical oxygen demand (BOD) while lignosuphates may be acutely toxic. While the risk of rupture is considered low, it is dependent on the overlying geology and porosity, coupled with the pressure of drilling fluids (DFO, 2007).

- Replacement of existing culverts - This approach will be required where there is inadequate headroom or where the structural integrity of an existing culvert (e.g. stone culvert) indicate a risk of collapse during trenching works. Works will occur in the dry as per damming and fluming methods above and a trench excavated for the duct and cable (TLI Construction Methodology, 2021).

The spatial extent of the proposed development, particularly as there are a number of linear elements, has the potential to directly impact on a number of watercourses, which are hydrologically connected to the Stracashel and Owenea Rivers and downstream FPM habitat.

The construction of temporary or permanent watercourse crossings poses potential detriment to the quality of a watercourse. In addition to the likely impact of exacerbating sediment movement/ loading when crossing water courses, constructing inadequate crossings has the potential to affect flow regime which is inextricably linked to sediment movement and thus overall FPM habitat quality. Crossings with designs insensitive to aquatic habitats could potentially be barriers to fish migration for species such as salmonids, which are the host species for the FPM and therefore any impact on the host will have implications for the conservation objectives of the FPM also. Chapter 10(v) deals with the potential impact on fisheries.

In the absence of mitigation this issue can have a direct impact on water quality, riparian habitats and flow regime important for FPM. Given the scale of the proposed development and assuming there is a need for a number of minor culvert extensions for road widening, new culverts within the windfarm site and the potential for trenchless and open cut crossing on the cable route crossing the magnitude of the impact is considered to be large adverse and with the sensitivity of the receiving surface waters assessed to be extremely high the environmental impact is potentially significant in the absence of mitigation.

10.5.7.3 Operational Phase

Hydromorphological impacts

The potential for the alteration in the hydromorphology of a water course through drainage, discharges and the presence of new structures such as culverts can have an adverse impact on the flow regime in the freshwater pearl mussel habitat.

The availability of suitable freshwater pearl mussel habitat is largely determined by flow (catchment geology being the other important factor) (NPWS, 2015). In order to restore the habitat for the species, flow variability over the annual flow range must be such that:

- high flows can wash fine sediments from the substratum;
- high flows are not artificially increased so as to cause excessive scour of mussel habitat;
- low flows do not exacerbate the deposition of fines or growth of algae/macrophytes and
- low flows do not cause stress to mussels in terms of exposure, water temperatures, food availability or aspects of the reproductive cycle.

There is the potential that significant engineering works could alter the flow and velocities in the water courses draining the windfarm site, which has the potential to impact on the flows in the main channel and could result in further deterioration of the habitat through the alteration of an already impacted flow regime, which is evident by the channel scour and bank erosion already occurring along the FPM habitat reaches surveyed as part of this assessment.

A hydrology impact assessment was carried out as part of the environmental assessment for the development under chapter 8, Hydrology & Surface Water to estimate the percentage increase in runoff from the site due to the development. The hydrology impact assessment at the Mully-Graffy site concludes that the increase in runoff will be imperceptible.

As part of the hydrology impact assessment, a site walk over was carried out to map the drainage from the site. During this site walkover it was noted that the site itself was not at risk of flooding. There was no evidence of flood damage having occurred in the past; no signs of erosion/under cutting of stream banks or gravel cast onto stream banks. The conclusion of the site walkover is that the construction of the site infrastructure can be completed with negligible change in current runoff characteristics.

The magnitude of the impact is therefore considered to be negligible and with the sensitivity of the receiving surface waters assessed to be extremely high, the environmental impact is imperceptible.

Fuel, oils and greases

Chapter 8, Hydrology & Surface Water identifies the potential sources of surface water contamination during the operational phase as:

- Use of a back-up generator at the substation which would be fuelled from a storage tank (typically 1,300 litre capacity). There is potential for leaks or spills with the impacts similar to those of the construction stage.
- Oils and greases used in the maintenance of the turbines will be brought to site as needed and waste oils will be taken from site as they occur by the turbine maintenance contractor. The oils and greases are used in the equipment within the turbine, isolated from the environment, so do not present a risk to the surface water environment.
- Cooling oils are used in the grid transformer at the substation. Depending on the model, the grid transformer holds 1,000L of cooling oil. These could leak /rupture, releasing oils into the environment. The oils need to be changed a few times over the lifetime of the transformer, which presents an increased risk of leaks / spills. The potential impacts from the oils associated with the transformer are similar to those of the construction stage fuel oil impacts.

Assuming the potential for minor to major spillage occurrences from the fuel storage tank associated with the generator the magnitude of the impact is considered to be large adverse and with the sensitivity of the receiving environment assessed to be extremely high the significance of the environmental impact is potentially profound for freshwater pearl mussel resulting in possible mortalities to the downstream populations in the absence of mitigation.

10.5.7.4 Project De-commissioning

The decommissioning process will involve the removal of all above ground structures, and reinstatement of disturbed areas following the completion of the wind farms operational lifetime. Some access tracks will be removed and others will remain for farm and forestry use. The decommissioning activities would represent similar impacts to those identified during the construction phase, but ultimately will result in a return to greenfield run-off characteristics.

10.5.8 Mitigation

10.5.8.1 Construction Stage

General

Measures to protect the surface water quality are set out in Chapter 7. These will be key to the protection of FPM given the surface water pathways that could result in an indirect impact on FPM habitat. Greater detail, including method statements where appropriate, is provided in the CEMP (Appendix 7.4). The CEMP includes details of earthworks (Chapters 5 and 6, and Method Statement No 2 – Road Construction, Method Statement; No 3 – Peat Management; Method Statement No 6 – Horizontal Directional Drilling and Method Statement No 7 – Grid Connection Construction Methodology, which provides additional detail on HDD). It also details Emergency Response Procedures for environmental incidents.

Pre-construction

A series of preconstruction investigations will be undertaken as detailed in Section 7.5.1 of Chapter 7, Water. Where trenchless crossings are required these investigations will allow techniques to be preferentially selected where recirculating water is not required which will avoid any direct impact on water courses and avoid requirement for the management of drilling fluids. Notwithstanding this mitigation, measures are proposed for trenchless crossings using recirculated fluids e.g. HDD.

Environmental/Ecological clerk of works

The developer will appoint an Environmental/Ecological clerk of works (ECoW) for the duration of the construction project. The ECoW will have an ecological and environmental management background with practical experience of wind farm construction projects. The ECoW will monitor the environmental aspects of construction (water quality, performance of surface water management infrastructure, etc.). The ECoW will have the authority to instruct the contractor to implement additional mitigation measures, if deemed appropriate. The ECoW will maintain a written record of all environmental issues on site, including incidents and monitoring results. This file will be made available to the relevant Authorities upon request. The ECoW will be responsible for notifying the relevant Authorities of any environmental incident. The CEMP details the role and responsibility of the ECoW.

Sediment Control

Mitigation and control measures to address the impact from suspended sediments associated with construction activities should follow good work practices and sound design principals. Contractors shall establish contact with the Inland Fisheries Ireland, Ballyshannon and the NPWS (particularly where works adjacent to aquatic habitats are within Natura 2000 sites) before works commence, with ongoing liaison throughout the construction. Contractors shall be familiar with the requirements of best practice and relevant guidelines including:

- Technical Guidance C648: Control of Water Pollution from Linear Construction Projects, (CIRIA, 2006)
- Technical Guidance C532: Control of Water Pollution from Construction Sites: Guidance for Consultants and Contractors (CIRIA, 2001);
- Requirements for the protection of Fisheries Habitat during Construction and Development Works at River Sites. Eastern Regional Fisheries Board (Murphy, 2004);
- Guidelines for the Crossing of Watercourses during the construction of National Road Schemes. National Roads Authority, Dublin, 2005.
- Guidelines for Fisheries Protection during Development Works (Foyle and Carlingford areas). Loughs Agency, 2011.

Details of the mitigation for sediment control has already been presented in Chapter 7 Surface Water and Hydrology and a summary of the measures are included below:

- ➢ Application of pollution prevention measures based on industry best practice as outlined by the Construction Industry Research and Information Associate (CIRIA);
- ➢ Surface water management infrastructure to be installed on mobilisation to site;
- ➢ Suspension of earthworks during averse weather to be monitored by the ECoW;
- ➢ Works on stream crossings will be carried out in dry weather as far as practical when low flows occur in the streams / drains;
- ➢ Clean surface water runoff will be diverted around earthworks areas to minimise the potential volume of silted water generated.
- ➢ Areas stripped of vegetation will be kept to a minimum. Areas along road verges and around hardstands will be reinstated / landscaped on an on-going basis as this infrastructure is constructed. Given the sensitivity of the receiving environment a

sediment control plan should be prepared well in advance of work commencing on site. When developing a sediment control plan the following steps shall be undertaken:

- Stockpiled soils will be kept a minimum distance of 50m from any watercourse. Silt fences will be placed downgradient of stockpiles to treat any polluted runoff
- Drains will be culverted under roads using suitably sized pipework. Streams will be crossed with bottomless (clear span) structures. A minimum 450mm φ culvert will be used.
- Check dams and or straw bales will be installed along the alignment of roadside drainage to slow flows and remove silt. Check dams will be constructed using clean stone and geotextile spanning across the drainage channel.
- The road and hardstanding areas will be constructed with aggregate – there will not be a hard-paved surface. This will reduce runoff volumes.
- If required, dewatering of foundations will be to temporary silt traps. Flow from the silt traps will be diffuse. The water would travel overland and any silt would be settled before reaching the drains or streams. As noted in Chapter 7, dewatering of foundation excavations is not envisaged.
- The public road serving the site will be kept clean of mud and debris so that silt is not washed to watercourses downstream of the site and outside the control of the wind farm development.
- Use of settlement ponds at the turbine locations. Water pumped from the foundation excavation or runoff from the works area will, where necessary, be directed to a settlement pond to remove silt and fines. The flow from the settlement ponds will be diffuse overland flow.

Site specific water and sediment management measures are outlined for each turbine location in Chapter 7 Surface Water and Hydrology.

Concrete

Concrete and cement compounds can have a deleterious effect on water quality and aquatic ecology. This is particularly the case where when construction is taking place over or in close proximity to watercourses. Given the sensitivity of watercourses within the study area, alternative construction methods to minimise the use of in-situ concreting near sensitive receiving waters will be investigated. For example the use of pre-cast or permanent formwork will reduce the amount of in-situ concrete and ready mix suppliers will be preferred to on-site batching.

Plant operating close to water shall be given special consideration in relation to the transport of concrete from the point of discharge from the truck-mixer to final discharge into the delivery pipe (tremie). Care should be exercised when slewing concrete skips or mobile concrete pump booms over open water.

Concrete wash out areas will be done at dedicated locations on site. These will be located at a number of locations around the site. The rinse down areas will consist of a settlement pond (3.5m wide, 5m long and 1.2m deep – minimum dimensions), lined with terram and stone filter. The following mitigation measures will be employed to prevent any pollution from wash out areas:

- Siting of concrete wash out areas will be located well away from water bodies:
- Surface water drainage will be controlled and these settlement ponds will not receive surface water runoff so capacity to receive rinse down water is always available;
- The release of cement to water courses will be prohibited.
- Regular maintenance of the wash out area will be required. Settled silt, surplus wet concrete and hardened concrete will be removed and disposed of in accordance with the appropriate waste legislation where it cannot be reused;
- Because of the its high pH, washout water may not be suitable for discharge to surface water drains and shall only be released to diffuse flow once pH has neutralised and confirmed by the ECoW.
- Signage will be erected at each concrete pour location directing drivers to the nearest rinse down area. These rinse down areas will be removed at the end of the construction phase.

Hydrocarbons and Other Pollutants

Chapter 8: Surface Water and Hydrology, outlines a series of measures to mitigate the probability of runoff of hydrocarbons including;

- Any storage of oils and diesel on site will be in steel or plastic tanks of good integrity and bunded to 110 % of tank capacity. All fuel and hydraulic fluids will be stored in the site COSHH store located in the site compound.
- Refuelling will be carried out directly from delivery vehicles. Refuelling of mobile plant will not take place within 50m of any sensitive receptor. Refuelling by mobile bowser may be used for small generators etc. Toolbox talks on refuelling will be given to delivery drivers in addition to plant operatives.
- Fuels, lubricants and hydraulic fluids for equipment used on the construction site will be carefully handled to avoid spillage, properly secured against unauthorised access or vandalism, and provided with spill containment according to best codes of practice.
- Any spillage of fuels, lubricants or hydraulic oils will be immediately contained, and the contaminated soil removed from the site and properly disposed of.
- Waste oils and hydraulic fluids will be collected in leak-proof containers and removed from the site for disposal or re-cycling.
- Appropriate spill control equipment, such as oil soakage pads, will be kept in the site plant to deal with any accidental spillage. Spare spill kits will be kept at the construction site compound.
- Foul drainage from site compounds and construction facilities will be contained and disposed of in an appropriate manner so as to ensure pollution of water bodies does not occur;

Emergency response plan

Chapter 8 of the CEMP details the Emergency Response Procedures for environmental incidents. This includes preparedness for such events, including training, responsibilities and maintain supplies on site for controlling environmental incidents (such as sandbags, straw bales, silt fencing, rip-rap etc.).

Detailed Mitigation for the Freshwater Pearl Mussel

The requirements of the Freshwater Pearl Mussel are more stringent than for other freshwater species and therefore there is a strong legal requirement to prevent any negative impact on both the habitat and the species itself.

The Stracashel and Owenea main channel are the most important river stretch due to the close proximity of live pearl mussels and habitat within the study area and therefore requires the most stringent measures during the course of the wind farm construction, grid connection and road access works.

However, as fine sediment movement through rivers and its settlement onto the river bed can cause formerly clean gravels to become clogged with fine sediment, prevention measures will also be required on all water bodies in the Owenea Catchment where works are proposed, i.e. the series of minor drains and streams to prevent indirect transportation of sediment into the main channel of the Owenea, as any fine sediment entering the water bodies upstream will continue to move in a downstream direction.

Due to the significance of this population and its current unfavourable conservation status no further deterioration in terms of water quality and population status is permitted.

A suitable qualified ecologist experienced in the requirements of the Freshwater Pearl Mussel shall be present throughout initial stages of implementation of the site mitigation measures, silt trap erection, spill preventative measures etc. in order to observe and direct (where necessary) in consultation with the Environmental Manager from the earliest stages. During this initial stage, the presence of an ecologist on site will allow for the opportunity to inspect the methods being applied and allow for initial assessment of the efficacy of silt traps/mats/mitigation measures;

Regular checks shall be undertaken by an experienced ECoW to ensure the management measures stipulated in the Construction Environmental Management Plan for the protection of the Freshwater Pearl Mussel and its habitat are been implemented by the contractor.

Tool box talks specific to the Freshwater Pearl Mussel and its habitat shall be undertaken by the ECoW prior to commencement of works onsite.

Multiple mitigation measures in terms of preventing silt release at source shall be employed. All construction must be designed such that silt must be trapped before entry to the river.

Measures to be employed to do this shall include:

- While the construction of silt traps, and silt fencing is already discussed under "Construction Mitigation" the detailed design, placement and maintenance of such measures shall be carried out in close consultation with ECoW and where necessary the

NPWS and IFI. A key factor in the design of such measures will be the on-going maintenance.

- Silt traps need ongoing monitoring both during and after construction operations have been completed to ensure that silt does not enter the watercourse.

- Where silt is removed from the traps it shall be deposited far enough back from the watercourse to ensure that it will not be carried back into the trap or river during subsequent rainfall. Once construction works have been completed, ECoW shall ensure that the condition of the site is such that there is no threat of silt entering the aquatic zone.

- This risk can be particularly high following dry periods when following subsequent heavy rain, wheel or track ruts from construction works which previously had been dry can act as channels through which silt can be transported to the aquatic zone. Before completion of all sites works the site agent or foreman must ensure that a thorough check of the site is carried so that that any mitigation measures deemed necessary to prevent negative impacts can be implemented before completion of works.

Watercourse Crossings

Cable installation across or below existing culverts

The depth and construction of some existing culverts means that the replacement of some culverts may be required as part of the cable construction and installation works while others will require nearby works that involve damming and diversion/ fluming to install the duct and cable (TLI Construction Methodology, 2021). This work will take place in a dry stream bed to mitigate the ingress of sediment and other pollutants. A method statement for these crossings has been prepared as part of the Construction Environmental Management Plan which sets out the controls that will be implemented to complete these works without resulting in significant sediment loading to the downstream freshwater pearl mussel habitat.

Trenchless crossings: HDD drilling

For directional drilling, a specialist contractor will be engaged. The HDD contractor will provide a site-specific method statement for this work. It will incorporate the measures detailed in the CEMP, including emergency response plan and Attachment 7 Construction Methodology 110kV underground cable, and includes the following measures:

- At each HDD crossing, a geo-technical investigation will be undertaken to determine the porosity of the underlying stream bed and to locate a suitable clay/ silt formation so that the risk of drilling mud break out can be ascertained. The depth of the bore may be increased subject to the investigation.

- Spatial buffers and sediment traps/ booms will protect sensitive waterways where HDD is undertaken. Drilling fluid leakage and bank-side disturbance will be prevented by ensuring that drill launch and receiver pits, are sufficiently distant from watercourses. The setback distances from the watercourses at the three HDD locations (i.e. the launch and exit pits) will be 50m, 20m and 25m for the Coillte Bridge, public road bridge and triple culvert, respectively.

- Construction of containment boxes at drilling exit/ entrance points will contain drilling fluids/ drill cutting. The steel boxes will be removed, with the drilling fluid disposed of to licensed facility (CEMP, Attachment 7).

- The safe removal (e.g. use of a vacuum lorry) and disposal of drilling slurry (drilling fluids and cuttings) will mean that there will be no discharge of this material to water courses sediment run-off to watercourses.

- An outline Frac-Out mitigation plan has been prepared as part of the construction methodology (Attachment 7 of The CEMP prepared by TLI Group). This outlines how the risk of break-out or drill fluid run-off will be monitored and managed during all phases of construction and will be finalised as part of the final contractors Construction Environmental Management Plan (CEMP). The Frac-Out mitigation plan includes a clear process including;

    - Full briefing of personnel with the plan and risks involved
    - Monitoring of drilling fluid pressure and viscosity by a fluid technician to ensure that readings are within expected values; any change indicative of the risk of a frac-out will be investigated and drilling ceased in such cases.
    - A frac-out watch programme will be implemented whereby "spotters" will monitor the ground surface above the drill path and the bed of the watercourse
    - If a frac-out occurs, drilling will be suspended and the frac-out will be contained using the following measures;
        - Sand bag containment at launch pits and riparian area

  - Available on-site tractor and bowser
  - Pumps
  - Physical plugging of the reamed bore using Enviro Formfill

- A procedure for conducting an emergency "clean-up" operation within the watercourse will be included in the full CEMP; this procedure will include contact points and methods of liaising with the NPWS, IFI and Donegal District Council.
- Measures to protect the watercourse will be erected before commencement of drilling. This will include silt fencing, sandbags and straw bales. Additional materials will be on hand in the event of a frac-out – refer to Appendix B in the TLI report included with in Attachment 7 of the CEMP for the 'frac-out' mitigation plan.
- Operations will to be limited to daytime hours and conditions when low levels of rainfall are forecast.
- The depth of the bore shall be a safe depth (minimum 2.5m) below the bed of the watercourse.
- The ECoW will monitor, or arrange for monitoring, drilling operations at all times.

10.5.8.2 Operational Stage

Hydromorphology

Chapter 10(iv) Fisheries and aquatic ecology highlights the mitigation that will be implemented to protect fisheries where there is a requirement to directly impact on the physical characteristics of a water body including:

- On watercourses with fisheries interests, clear-span or bottomless culverts are preferred over box/ pipe culverts as they preserve the existing bed,;
- Where clear span or bottomless culverts are used, adequate sizing is required to `allow for light penetration, prevention of debris accumulation, and retention of the existing channel profile.
- Box culverts are preferred over round pipe culverts but only where approved by IFI; they should be embedded to at least 300mm below the existing bed level (as proposed by TLI in the construction method for any replacement culverts) to ensure that fish passage is unobstructed

- Where the natural bed is not retained (box/ pipe culverts), material similar or of better quality to the original bed should be placed; clean washed rounded river gravel and cobble are recommended.
- A significant change is gradient (>3%) should be avoided; where gradients will exceed 5%, baffles will be required to break up flow and facilitate fish movement.
- Any bank protection upstream or downstream of the culvert should be conducted so that undercutting or destabilisation of the culvert is avoided.

Measures to retain greenfield run-off rates are highlighted in Chapter 7 Surface Water and Hydrology and include:

- To mimic as close as possible greenfield runoff rates and volumes, permeable finishes on roads and hardstands will be used. Break-out points will be provided along the length of the roadways to send water onto the hillside to its natural drainage pathway; water will not be delivered to drains / streams from long sections of new roads.
- Vegetation will be allowed develop in the roadside drain. This will slow flows and reduce erosion potential.
- No direct discharge of development storm water into the existing natural watercourses within the site.
- Rainfall concentrated at the turbine towers will be collected and discharged to a level spreader downhill from the turbine.
- Clay plugs will be installed along the length of the cable trench to eliminate these acting as preferential pathways.

Fuel, oils and greases

The backup generator at the substation will require a fuel storage tank (1,300 L) this will be appropriately bunded and the same controls as outline for fuel, oil and greases in the construction phase mitigation will apply during the operational stage where relevant.

10.5.9 Monitoring

Monitoring needs to take place for a timescale that reflects the risk period to the FPM population. This includes site preparation, the full construction period, until full revegetation has occurred, and during operational phases if a risk to the freshwater pearl mussel population is possible, e.g. if settlement ponds are still operational.

Chapter 7 Surface Water and Hydrology provides the details of the monitoring that will be undertaken during construction and the ongoing inspection of drainage during the operational phase of the development to ensure the risk to water quality and the downstream freshwater pearl mussel habitat is not significantly impacted.

10.5.10 Residual Impacts

The likely significant effects of the Proposed Development were assessed for the construction, operational and potential decommissioning phases of the development. In terms of adverse impacts on the FPM there are no direct impacts on the populations in the Stracashel River and Owenea River or their habitat however there is potential for indirect impacts. The significance of the impacts were assessed to be negligible to very large adverse in the absence of adequate mitigation measures. With the implementation of the mitigation measures proposed in the EIAR, the assessment of the residual impact from the Proposed Development is considered to be negligible.

10.5.11 Cumulative Impacts

The definition for cumulative impacts used in the Institute of Environmental Management and Assessment (IEMA) guidance on EIA originates from the US Council on Environmental Quality, and is as follows:

"the impacts on the environment which result from incremental impacts of the action when added to other past, present and reasonably foreseeable future actions..."

Cumulative impacts therefore can cover all aspects of the environment. While a single activity may itself result in a minor impact, it may, when combined with other impacts (minor or significant) in the same geographical area, and occurring at the same time, result in a cumulative impact that is collectively significant.

In the context of freshwater pearl mussel and supporting habitat/water quality it is important to consider hydrological connectivity when considering cumulative impacts and the catchment based approach should be central to any assessment. The assessment based on water bodies ensures that past and present activities are accounted for in the baseline and therefore the impact assessment.

There are no significant impacts likely from the proposed development during the construction, operation or decommissioning phases, which would result in either positive or negative cumulative effects with other developments. There will be no discernible change to the existing baseline water quality environment as a result of the proposed development and therefore no potential for significant cumulative effects with other projects are anticipated.

10.5.12 Transboundary Effects

Part of the study area associated with the proposed development is within the Upper Foyle Catchment. The Foyle catchment is a cross border catchment and therefore the hydrological link extends to areas beyond the international border in in the River Foyle and Lough Foyle. The project is hydrologically linked to both the Foyle and Tributaries SAC and the Lough Foyle SPA in the Republic of Ireland. However the residual impact after the implementation of the mitigation measures is assessed as negligible and therefore there will be no potential for significant transboundary effects on water quality as a result of the Proposed Development particularly given the distance from the development site to these features.

10.5.13 Interactions

The freshwater pearl mussel requires a very high standard of water quality, natural flow regime and is dependent on salmonids during the glochidia stage of its lifecycle therefore as a water dependent species in the water bodies affected there is a strong interaction with surface water quality and hydrology and fisheries and aquatic ecology. The protection of the water environment and aquatic ecology will help to ensure that freshwater pearl mussel ecology is not significantly impacted by the implementation of the SHD.

Geology and soils also has a strong interaction with the water quality, and therefore freshwater pearl mussel, with the interaction of surface and sub surface water important to the generation of run-off and the mitigation of same.

10.5.14 Conclusion

The proposed Graffy wind Park development, including the proposed cable connection route, areas of road widening, and construction of a new access road, is located in the headwaters of two different river catchments (Owenea and Finn). Both rivers are significant, the Finn due to Atlantic salmon stocks and their occurrence within SACs and an extant population of freshwater pearl mussel. However the most recent comprehensive surveys could not find any pearl mussels. The Stracashel River, a tributary of the Owenea and the Owenea itself support populations of FPM. The principal risk to freshwater pearl mussel in general will be during the construction phase of the proposed development with the risk associated with fine sediment loading to the receiving watercourses which in the upper reaches of these catchments and the potential for alterations in the flow regime.

A series of specific mitigation measures have been designed to address, prevent and mitigate negative impacts on freshwater pearl mussel with regard to construction, operational and decommissioning phases of the project. Implementation of these measures will mitigate any significant effects relating to run-off of suspended sediments, release of pollutants, deterioration of habitat, thus ensuring that the overall significance of effects will be negligible with regard to potential for impact to aquatic ecology of local rivers, in particular the Stracashel/ Owenea and the Stranagoppoge/ Finn, as the most sensitive receptors.

Chapter 10(iv) assesses the potential impact on fisheries and aquatic ecology and in particular salmonids, which an important part of the fresh water pearl mussel life cycle. This assessment concludes that the impact to these species will not be significant with the full implementation of the mitigation measures recommended.

10.5.15 References

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11. Roads and Traffic

Contents

Drawings 19-014-SPA-001 to 19-014-SPA-005 included in Appendix 11 of Volume 3B of EIAR document.

11. TRAFFIC AND TRANSPORT.

This chapter assesses the delivery of materials and equipment to the site during the construction phase and traffic associated with the operational phase of the wind farm. It considers the different elements of the construction phase and assesses the capacity of the existing roads to deal with this traffic. As the proposed wind farm will be constructed at the same time as the grid connection to Tieveback EirGrid substation the cumulative impacts associated with transport and traffic are assessed.

11.1 Existing Network

Direct access to the site will be provided by the existing local roads network to both the east and west of the site, which is currently used only by local traffic and therefore experiences very low usage. Wider service access to the site will be off the R252 at Bellanmore and along local roads L2023, L6733 and L6743. All construction equipment will be delivered to the site via this route as will import of quarry materials/disposal of unsuitable material as necessary. This route will require some localised upgrades to accommodate deliveries of some turbine elements with some temporary widening also required along the wider delivery route indicated below.

Figure 11.1: Turbine Delivery Route.

11.2 Traffic Generated by the Works

As suggested above, this chapter is structured to assess the traffic impact during two distinctive elements of the works:

- Enabling Works to include construction of any required site roads, turbine foundations and ancillary installations (cable, compounds etc.)

- Delivery/Installation of turbines to include transportation of individual turbine elements and associated lifting equipment.

11.3 Enabling Works

To facilitate transportation of the turbines from the port of entry at Killybegs to the windfarm site at Graffy and installation on site, a range of advanced enabling works will be required – namely construction of site roads, installation of assembly platforms, laying of fibre optic/electrical cables and pouring of turbine foundations.

11.3.1 Site Roads

There is approximately 4.5km of newly constructed site roads required to link the existing road network to each of the 8 individual turbine sites. This will involve excavation/deposition of material to sub-formation level before importing suitable material to create site road. Table 11.1 below shows a break down of the quantities associated with the above works elements and the corresponding construction traffic.

Table 11.1·. Traffic associated with site road construction

Works Element	Quantity of material	Total number of vehicular trips (arrivals and departures)
Excavation/deposition	4 6500m^3	Up to 14,000 peat depositions to adjacent recovery areas & turves (standard 6T dumper)
Import of selected granular fill	10,500m^3	1400 (standard four axle lorries)

11.3.2 Assembly Platforms

Once the delivery track has been installed between the existing road network and turbine site, an assembly platform will be built adjacent to the turbine site, which will be used for unloading of individual turbine elements on delivery, assembly of elements and lifting into place. All these operations will be undertaken by a crane, which will also be accommodated within the assembly area. Construction of these assembly areas will involve excavation of unsuitable material to sub-formation level before importing suitable material to achieve the required load bearing capacity to accommodate a crane.

Table 11.2: Traffic associated with asse mbly platforms

Works Element	Quantity of material	Total number of vehicular trips (arrivals and departures)
Excavation/deposition	19,500m^3	1,300 (standard four axle lorries)
Import of fill	9,750m ^{3}	650 (standard four axle lorries)

11.3.3 Cable installation

On completion of each turbine there will be a set of cables linking each to the substation proposed as part of the works – a total of 5km. Installation of these cables will require excavation of a trench to accommodate 2no ducts bedded and backfilled with lean mix before reinstatement with selected granular fill/ road surfacing material.

The windfarm substation will also connect to the nearby Tievebrack ESB substation located nearby at Drumnalough requiring approximately 7.3km of trench to be excavated between the two. Within this trench there will be a trefoil electrical cable arrangement bedded and surrounded in lean mix concrete with a granular backfill and fully sealed reinstatement.

Table 11.3 below shows a breakdown of the various materials work elements involved in laying the cable, the material quantities involved and associated vehicular movements.

Table 11.3: Traffic associated with cable installation

Works Element	Quantity of material	Total number of vehicular trips (arrivals and departures)
Excavation/disposal	22,000m^3	1,450 (standard four axle lorries)
Import of lean mix bedding surround	8,900m^3	1,115 (standard concrete lorries)
Import of granular backfill	8,800m^3	590 (standard four axle lorries)

11.3.4 Foundation Construction

The foundations for each turbine will involve laying a sub-formation, fixing of steel reinforcement and pouring of concrete to complete the foundation. Table 11.4 below indicates the traffic associated with the various work elements.

Table 11.4: Traffic associated with foundation construction

Works Element	Quantity of material	Total number of vehicular trips (arrivals and departures)
Steel Reinforcement	84.41t per turbine = 675.28t	32
Concrete Pour	640m^3 per turbine = 5,120m^3	1280 @ 8m^3 per concrete HGV
Foundation insert	8 units	3

11.3.5 Ancillary Traffic

Ancillary traffic will include staff travelling to and from the site, delivery of materials, equipment refuelling and repairs. Table 11.5 below shows predicted numbers of vehicular trips for each of these supplementary traffic generations.

Table 11.5: Ancillary Traffic

Category		Total number of vehicular trips (arrivals and departures)
During construction	Staff	40 daily (cars)
	Deliveries	4 weekly (articulated HGVs)
	Refuelling	2 weekly (standard oil lorry)
	Repairs	4 monthly (standard vans)
After construction	Commissioning	2 monthly
	Scheduled Maintenance	2 weekly (standard van)

11.3.6 Cumulative Impacts

No significant cumulative impact is envisaged on the local road network. There may be some overlap in concrete and stone deliveries to both sites along the R252, however, the regional road network is designed to accommodate these levels of traffic.

Construction of the grid connection between Meenagrubby and the Tievebrack control room/substation is not expected to have any significant cumulative impacts with the construction traffic associated with the Graffy Wind Farm, particularly along the western section of the grid connection route, a significant section of which will be along the private road serving the Tievebrack ESB substation. On the public roads section of the grid connection, there will be significant disruption to local traffic, due to road closures. However, it is acknowledged that traffic levels on these local roads is negligible and fortunately there are alternative routes to the R252, to facilitate access to Glenties, Letterkenny and Ballybofey/Stranorlar.

11.4 Delivery & Assembly of Turbine Elements

The port of entry for all turbine elements will be Killybegs from which point each of the individual turbine elements will be transported by road to the proposed windfarm site at Graffy. Table 11.6 overleaf offers a breakdown of the individual elements for all 8no turbines.

Table 11.6: Traffic associated with Turbine Element Deliveries

Turbine Element	Number of Items	Total number of vehicular trips (arrivals and departures)
Blades	3	48 (extended articulated transporters)
Nacelle	1	16 (extended articulated HGVs)
Towers	3	48 (extended articulated transporters)
Blade hub	1	16 (standard HGVs)
Cables	1	16 (standard HGVs)
Generator	1	16 (standard HGVs)
Assembly Crane		25

The delivery route will be along the established national, regional and local road networks identified above in Figure 11.1 – a route that includes some spatial and weight capacity constraints.

11.4.1 Spatial Constraints

The delivery route is a recognised one that has successfully accommodated large turbine delivery on many previous occasions.

The turbines will be delivered to Killybegs. The longest component is the Nordex 133 blade at 64.4m long, which dictated the delivery route. The proposed delivery route from Killybegs, County Donegal is summarised as follows:-

- Killybegs port to Donegal town via the regional road R263 and national road N56;
- From Donegal town follow the N15 north to the Roadhouse junction with local road L-2794-1, approximately 3kms west of Ballybofey;
- Travel along the L-2794-1 to its junction with the R252;
- Travel west along the R252 to Bellnamore;
- Take the L-2023-1 to its "T" junction with the L-6733-1;
- Travel along the L-6733-1 to its junction with the L-6743-2;
- Travel southwest on L-6743-2 to the site.

The greatest delivery effect on the road network will be on the days during the delivery of the abnormal indivisible loads (AILs) comprising the tower sections, the blades and the nacelles. Traffic management measures will be established, providing for the following:-

- Identification of a delivery schedule;

- Details of the alterations required to the infrastructure and any other minor alterations (hedge rows etc);
- A dry run of the route using vehicles with similar dimensions.

The transport of AILs can only be done following a comprehensive route selection, route proofing and consultation with An Garda Síochána and the local authority road section. Turbine components are usually transported at night when traffic is light and this is done in consultation with the appropriate authorities. In some cases, temporary accommodation works are required along the turbine delivery route e.g. hedge/tree cutting, temporary relocation of lampposts, signage and local road widening.

It is not anticipated that any sections of the local road network will be closed, although there may be delays to local traffic if deliveries are made during daylight hours. In those circumstances, local diversions may be operated. However, it is anticipated that all the deliveries comprising out-sized loads will be made outside the normal peak traffic periods to avoid disruption to work and school related traffic.

There are particular locations along the route where the alignment may offer a confined delivery corridor when transporting the largest element – the turbine blade. Vehicle swept path analyses will be required to confirm that passage is achievable for this particular element. These have been identified as follows:

- Horizontal alignment approximately 550m south of Bruckless Bridge;
- Junction at Roadhouse Bar
- Junction at Cappry (intersection of R252 & L2794)
- Junction at Bellanmore (intersection of R252 & L2023)
- Proposed horizontal realignment through Coillte lands.

Drawings 19-014-SPA-001 to 19-014-SPA-005 enclosed in in Appendix 11 of Volume 3A - Appendices of the EIAR, show vehicle swept path analyses for each of the junction listed above and show what specific measures are required to facilitate passage through these constrained locations.

11.4.1.1 Bruckless Bridge

With reference to drawing 19-014-SPA-01, there will be a requirement to temporarily remove chevron signage and widened haul road into the south western verge. Both these features will be reinstated following all deliveries.

11.4.1.2 Roadhouse Bar

With reference to drawing 19-014-SPA-02, there will be a requirement to temporarily remove a street lighting column directly adjacent to the entrance to the Roadhouse Bar, which will be reinstated following all deliveries.

11.4.1.3 Cappry Junction

With reference to drawing 19-014-SPA-03, there will be removal of boundary walls and hedging to the bungalow along the western edge of the road. The applicant has an agreement with the house owner of the affected property, subject to a favourable planning permission. Some areas of temporary road widening will also be required to facilitate manoeuvrability through this area.

11.4.1.4 Bellanmore Junction

With reference to drawing 19-014-SPA-04, removal of fence lines and gates together with some localised road widening works will be required to facilitate delivery through this area. These works are solely for the benefit of the delivery and will be reinstated to the previous condition subsequently.

11.4.1.5 Coillte Lands

With reference to drawing 19-014-SPA-05, a realigned stretch of haul route will be required to facilitate delivery at the junction of the L-6733-1 and the L-6743-2. Removal of the corridor of forestry has been agreed with Coillte and will form part of the formal planning application. This corridor will be used as a future forestry road for Coillte and therefore no reinstatement is required.

11.4.2 Weight Capacity Constraints

There are a number of bridge structures along the delivery route – most of which are located along the recognised delivery route identified previously between Killybegs Port and Cappry Village. Table 11.7 below identifies those structures located between Cappry Village and the windfarm site at Graffy. Bridges and culverts along the national and regional road network and along the L-2794, between the N15 and the R252, are considered sufficiently robust to facilitate the turbine deliveries.

Table 11.7: Bridge Structures under consideration

Structure	Townland Location	Lat/long
Bridge	Welchtown	54.814290°, -7.872149°
Bridge	Kinaderry	54.818956°, -7.884873°
Bridge	Cloghanmore	54.828649°, -7.928596°
Bridge	Brockagh	54.853583°, -7.947835°
Bridge	Letterbrick	54.858530°, -7.969529°
Bridge	Meenagolan	54.864422°, -8.008126°
Bridge	Bellenamore	54.867580°, -8.058066°
Bridge	Lughveen	54.853861°, -8.073844°
Bridge	Tievereagh	54.840035°, -8.110805°

Table 11.8 below indicates the heaviest weight for each of the turbine elements together with the assembly cranes. The heaviest weight per axel load will be 12 tonne. These will be checked against the weight capacity of the structures above to confirm their suitability.

Table 11.8: Turbine and Crane Element Weights

Element		Cargo Gross Weight (t)
Turbine	Blade	21.8
	Generator	47
	Hub	46
	Nacelle	39.5
	Tower Section 1	82.35
	Tower Section 2	74.94
	Tower Section 3	79.48
Crane	On-road travel unit	48
	Outriggers	4 x 12
	Superstructure	38
	SA-frame	18
	Winch	8.4
	Crane Mat	7.8
	Counterweight Part A	10
	Counterweight Part C	12.5

11.4.3 General upgrades along length of delivery route

Upgrade works, such as strengthening of the soft margin, support / reinforcement to culverts along the local roads leading to the wind farm site will also be required. It is anticipated that these works will be retained, following the turbine deliveries. The works are outlined on Drawings 19-014-RW-001 to 19-014-RW-011, which are contained in Appendix 11 of Volume 3A -Appendices, of the EIAR.

11.5 Potential Traffic Impacts

The potential impacts on traffic and roads associated with the proposed development during the construction phase includes:-

- Increase in local daily traffic (Tables 11.1 - 11.5), in particular an increase in standard four axle lorries carrying concrete and stone. There will also be an increase due to workers to and from the site and often the construction of wind farms will attract on-lookers.
- Transport of oversized loads (Table 11.6) at 10 per turbine – with an additional 4 normal loads, approximately, for turbine components delivery.
- Delivery of the cranes to the site (Table 11.6) – approximately 25 for the 2 cranes. This will depend on the type of crane used during turbine installation, but 25 loads are a worse-case scenario.
- Modification of roads to accommodate easement sweeps at corners (Drawings 19-014-SPA-01 to 19-014-SPA-05, contained in Appendix 11 of Volume 3A -Appendices, of the EIAR.)
- Long term interaction of grid connection operations with on-site wind farm construction activity.

11.6 Summary of Mitigation Measures

11.6.1 Delivery of Turbine Elements

To mitigate against the impacts of traffic associated with the project, the following mitigation measures will be undertaken:

- Prior to the commencement of construction, a Traffic Management Plan will be agreed with Donegal County Council. This will include the following:-
    - Route condition survey of local roads;
    - Agreed delivery route for concrete and stone. This will include a one-way-system as far as possible to minimise conflicts with HGVs meeting on the local road network;
    - Agreed delivery route of the over-sized loads for the turbines, including any road improvements needed, including support of local bridges;
    - Speed limits for HGVs on local roads to / from the site.

- Provision of traffic control while transporting oversized loads to the site. A specialist contractor will be employed for the AIL deliveries, who will liaise with the authorities to organise the deliveries and secure the necessary permits. A dummy-run will be carried out using a telescopic trailer to confirms that the route is suitable.

- Deliveries of AIL will be during off peak hours (i.e. typically before 06:00hrs), so disruption to other road users is minimised. Parking facilities will be provided on site for construction traffic.

11.6.2 Construction of Grid Connection

Mitigation measures to be employed during the construction of the grid connection to minimise its direct and cumulative impacts are:-

- Prior to the commencement of construction, a Traffic Management Plan will be agreed with Donegal County Council. This will include the following:-
    - Securing the necessary road opening licences.
    - Route condition survey of local roads.
    - Agreeing a programme for road works and route for delivery of construction material, taking account of the delivery routes and construction programme for the Graffy Wind Farm.
    - Agree traffic diversions to minimise conflicts with construction traffic associated with the grid connection, traffic associated with wind farm construction and other road users.
    - Speed limits for HGVs on local roads to / from the site.

- Parking facilities will be provided at a construction compound at Meenagrubby for construction traffic.

- The roads will be repaired and resurfaced to make good any damage, including roadside drainage. The roads will be left in a similar or better condition than that recorded during the road condition survey.

Having regard to the very low levels of local traffic, the construction works will have an imperceptible impact, as road diversions will be in operation. There are sufficient local road alternatives, to accommodate diverted traffic. On a long-term basis, once the site is in operation, it is anticipated that the operational wind farm and the proposed turbines will not generate any adverse impacts on traffic in the vicinity of the site.

12.MATERIAL ASSETS

Contents

This chapter of the EIAR describes the material assets associated with the site and its environs, the potential impacts of the proposed development thereon and the proposed mitigation measures to avoid or reduce potential impacts. It assesses the cumulative impact on material assets of the proposed turbines with the other permitted and operational wind farms in the area, as well as the proposed grid connection.

12.1 Material Assets in Existing Environment

Material assets are described in the EPA guidelines as '*resources that are valued and that are intrinsic to specific places are called 'material assets'. They may be of either human or natural origin and the value may arise for either economic or cultural reasons. Examples of natural resources of economic value include assimilative capacity of air and water, non-renewable resources (e.g. minerals, soils, quarries and mines), renewable resources (hydraulic head, wind exposure).*

Many of the aspects of material assets are addressed in other chapters of the EIAR, including:-

- The cultural assets (archaeology, monuments, historical sites, etc.) are discussed in Chapter 10.
- Geological heritage in Chapter 6.
- Landscape in Chapter 3.
- Roads and Traffic Chapter 11.

Other material assets associated with the site and its environs are discussed below.

12.1.1 Wind Energy Resource

Wind energy has the following attributes:-

- It is the country's biggest energy resource.
- It is clean, renewable and sustainable as a means of electricity generation.
- It is a cost-effective energy options for reducing global warming.
- The operation of a wind farm has practically zero emissions.

The site of the proposed development is located in an area suitable for wind farm development. It is in an exposed area, with good predicted wind speeds. The site area can accommodate eight turbines as demonstrated by the previously permitted development. These can contribute an additional 35.88 MW of renewable energy generation.

12.1.2 Electricity Resource

Government targets for electricity generation from renewables require an additional 3,900MW of installed wind farm capacity. In GATE 2, 1,450MW was processed. The Graffy Wind Farm, of 35.88 MW capacity has applied for and included in the RESS-1 auction. Having local embedded generation capacity is a benefit to the electricity transmission and distribution networks – there are less losses associated with local embedded generation as the power generated is largely consumed locally.

12.1.3 Forestry Resource

While there is commercial forestry adjacent to the site, forestry resources will only be minimally affected by keyhole felling. Felling will be required at a new access route adjacent to local road L-6733 to the northeast of the wind farm, easement of bends along the delivery route, bat impact mitigation around T1, T4, T5 and T6 and at turbine tracks to T1 and between T4 and T5/T6. Felling of approximately 6.656 ha of forestry in total will be required and forestry felling is addressed in detail in Chapter 2, paragraph 2.7 above.

12.1.4 Agricultural Resource

The wind farm is located in a rural upland area in the upper catchments of the Stracashel and Stranagoppoge Rivers and along the foothills of Aghla Mountain. The turbines are located to the north of local road L-6743. Housing is sparse in the immediate area, consisting of a few farmhouses along the local road, a number of which are now derelict. The land use is primarily rough grazing for sheep. Conifer plantations are widespread in the area, with forestry within the central part of the site, and adjacent to the eastern site boundary. There is evidence of small-scale historic turf cutting at the site; active turf cutting is occurring in the general area, particularly at the low-lying elevations. The site substation is located to the south of local road L-6743 in improved wet grassland, used for sheep grazing.

The grid connection to the ESB substation follows local roads L-6743 and L-2593 to the east towards Glenties. Housing density increases to the east with farmhouses and ribbon development occurring. Land use consists primarily of low intensity agriculture and forestry. Parts of the site are used for rough grazing of sheep. This activity can continue following the construction of the wind farm.

12.1.5 Industrial Minerals and Rocks

According to the Directory of Active Quarries, Pits and Mines in Ireland, there are no pits or mines in the vicinity of the site. Overburden is expected to be deep at the site, so potential for rock extraction is very low. The overburden is gravelly in places, but with a high clay content. While suitable for bog road construction, it has low potential for commercial gravel extraction.

12.2 Potential Impacts on Material Assets

The development of the wind farm will have positive and negative impacts upon the material assets in the receiving environment.

12.2.1 Positive Impacts on Material Assets

- In addition to reducing harmful atmospheric emissions, wind energy is an indigenous, secure and sustainable resource in contrast to fossil fuels, which are ultimately unsustainable. Current rates of use of fossil fuels (coal, oil and gas) are 300,000 times greater than the rate at which these fuels are naturally created. The development of wind energy slows down this depletion and offers an alternative power source.
- The wind farm will make effective use of an exposed site, which has a low usage intensity. The local climatic conditions are very suitable for such development. The local wind resource can be considered a material asset, which will now be utilised.
- The development of wind energy projects in rural areas provides an increased income for landowners, as the utilisation of their land can be diversified.

12.2.2 Negative Impacts on Material Assets

Although the Graffy area in which the wind park is proposed, is designated as Especially High Scenic Amenity, it is not an important area for tourists. Tourism is recognised in the Donegal CDP 2018-24 as playing an important contribution to the socio-economics of the County and is strongly encouraged. The scenery of County Donegal is a primary tourist attraction. There are a range of attractions from mountains, lakes, rivers, coastline, woodlands etc. with their associated activities including trekking, hill walking, mountaineering, fishing, sailing etc. Tourist attractions in the vicinity of the site include the Wild Atlantic Way (WAW). However, the WAW route is over 10kms to the west at its closest point at Lettermacaward and generally hugs the western seaboard of Donegal. The wind park is not visible from Lettermcaward, but long distance views of the wind park will be seen from short sections of the WAW over 17kms from the site.

Apart from the WAW, there are no designated scenic roads in the vicinity of the wind park site and no designated views or prospects overlook the site. The Sli na Finne a 42m section of the Sli Dhun na nGall, passes close to the site to the east and north. Viewpoint 3 in the LVIA chapter 3, is located along this walking route and is representative of views from along this section of the route. At this location, both the formerly permitted and proposed development will be visible and clearly perceived by receptors. While the increased height of the proposed turbines will lead to a slightly more prominent presentation of the development in the landscape, overall there will not be a significant increase in effects.

Wind turbines can be considered to be an environmentally benign approach to energy generation or alternatively as an unwelcome intrusion on the landscape. To date there has been no evidence to suggest that tourism in an area may be negatively affected by the presence of a wind energy facility.

The proposed grid connection route from the substation at Meenagrubby to Tievebrack ESB station is approximately 7.5km long and will be underground. Accordingly, it will have no impact on material assets during the operational phase of the wind farm. Construction of the grid along public roads will have a temporary negative impact on the local road network, with some short-term traffic disruptions expected.

12.3 Mitigation Measures

There are no mitigation measures required.

12.4 Conclusions on Material Assets

Wind energy is one of Ireland's largest, commercially viable energy resources, and is also a clean, renewable, and sustainable means of electricity generation. The proposed wind farm will increase the electricity resource, without compromising other natural resources in the area. The overall impact of the wind farm on the material assets of the area is therefore positive.

13. Electro-magnetic Transmissions

Contents

The electromagnetic communication systems in the existing environment, the potential impact of the development thereon and proposed mitigation measures are presented below.

The rotating blades of a wind turbine may occasionally cause interference to electro-magnetically-propagated signals. Such interference can, in theory, have an impact on all forms of electromagnetic communications as follows:

- Satellite communications
- RADAR
- Cellular radio communications
- Aircraft instrument landing systems
- Terrestrial microwave links
- Television broadcasts.

An assessment was carried out of impacts of the Graffy Wind Farm on local telecommunication systems. That assessment addressed TV, radio and mobile communication. In addition, the potential impact of wind farms on the operations of IAA (Irish Aviation Authority) radar installations was appraised.

12.1 Potential Impacts on Electro-Magnetic Signals

Interference to a communication system that is based on the propagation of electromagnetic waves can be as follows:

- During the construction phase there is likely to be power tools in use which will have electromagnetic emissions.
- Electromagnetic Interference (EMI) that emanates from the turbines.
- Signal scattering results from the obstruction presented by the blades, an effect that mimics the presence of a lower power source that operates from the location of the wind turbine.
- Signal obstruction as it passes through the area swept by the rotating blade.

12.1.2 Electro-Magnetic Interference – Construction Phase

The electromagnetic emissions from power tools and / or generators are common as these tools are in wide use at building sites throughout the country. All these devices are required to comply with EMC Directive 89/336/EEC, which ensures that they do not cause interference with other equipment. It is therefore not anticipated that there will be interference from these sources during construction.

12.1.3 Electro-Magnetic Interference from Turbines

An electric generator or motor will generate electromagnetic energy that will be propagated in the vicinity of the machine. A wind turbine operates in the same manner. Wind turbines are required to be tested prior to sale, which ensures that it meets the required European standard with regard to level of emissions (EN 55011) and immunity to interference (EN 61000). Electromagnetic interference is not expected to be a problem.

12.1.4 Signal Scattering

Large wind turbines can act as sources of re-radiation. They produce delayed 'ghost' signals that are altered in amplitude by the rotation of the blades. The amplitude of the re-radiated signals is greatest when the plane in which the blades rotate is orientated so that the angle of incidence, and reflection are equal. This is called the 'specular reflection' condition. Specular reflection may occur for some proportion of the time, as the blade of the wind turbine will turn into the wind about a vertical axis.

12.1.5 Signal Obstruction

Wind turbines obstruct the path of the wanted signal and therefore reduce the signals strength. This obstruction occurs when the turbine turns through 90° as a result of the specular reflection condition. This effect is less significant than the generation of delayed signals that cause picture degradation. This effect needs to be avoided in the case of point-to-point networks.

12.2 Assessment

Digital terrestrial TV (Saorview) has replaced analogue transmissions since 2012. The use of digital TV has mitigated TV reception interference from turbines. For mobile phone communications, it appears that the masts are not transmitting through the site.

12.3 Consultation

A number of communication providers were consulted to determine whether the proposed wind farm would impact on their signals. The operators contacted and their responses are summarised in Table 12-1. It should be noted that Tetra Ireland was appointed by the Irish Government in 2006 to build and operate a National Digital Radio Service (NDRS). The telecommunications service it provides is used by both Government and private customers, including An Garda Siochana, Irish Coast Guard, Mountain Rescue Ireland, BT, Civil Defence, Eir, IAA, HSE National Ambulance Service, Air Corps, RNLI etc. Its response therefore reflects the position of a large number of users.

Table 12-1: Summary of Communication Providers Consultation

Operator	Response Received	Response Summary
IAA	Yes	No objection
RTE	Yes	No objection, subject to a protocol being signed between 2RN and the developers to protect potential interference to DTT viewers, should the site be built.
Digiweb	No	
Tetra Ireland	Yes	No objection
Garda	No	
TG4	No	

12.4 Cumulative Impacts

The closest operational wind parks to the Graffy site are the Loughderryduff wind farm, located approximately 14.5km due west and the Cloghan wind farm approximately 14.5km due east. There have been no complaints associated with electromagnetic interference from either wind farm. No cumulative impacts are envisaged between the Gaffy Wind Farm and the operational and proposed wind farms. Nor are there any cumulative impacts envisaged between the wind farm and the grid connection to Tievebrack substation.

12.5 Mitigation Measures

No mitigation measures are required in relation to electro-magnetic radiation from the turbines, as levels are negligible.

Remedial measures for EM signal interference are not difficult to implement. They are relatively inexpensive, and will be undertaken by the developer, if required.
Such measures could include:

- Antenna relocation.
- Replacing aerials with more directional types.
- Relaying of signals around the wind farm site using another transmitter.
- Relaying of signals through the site using deflectors mounted on the turbines.
- Cabling of signals underground through the site.
- Installation of booster signals.

Digital terrestrial TV has mitigated the potential for impacts on TV reception from the turbines.

12.6 Conclusions on Electromagnetic Effects

The proposed wind farm is unlikely to cause any electromagnetic interference. RTE generally require that wind farm developers enter into an agreement (protocol) which obligates the developer to rectify any deterioration in TV and radio reception resulting from the wind farm. The applicant is prepared to enter this agreement with RTE. With the use of digital terrestrial TV, the impacts on TV reception from the turbines are expected to be avoided completely.

14.Interaction of the foregoing.

Contents

BACKGROUND

The impacts of the proposed development have been assessed for the various aspects of the environment, as discussed in the preceding chapters. While these assessments are not conducted in isolation, their focus is on the specific aspect of the environment under consideration. This chapter reviews all the aspects of the environment and identifies interactions between them. Table 14-1 summarises the interactions for both the construction phase (C) and operational phase (O) of the wind farm extension. Each aspect of the environment is listed on the left column and the top row. The interactions are discussed in terms of the impacts associated with the aspect of the environment listed in the column with the aspects of the environment listed across the row. For example, the impacts of the wind farm associated with landscape are discussed in terms of their interaction with each of the other aspects of the environment. The interaction is therefore not necessarily reciprocal.

Table 14-1: Interaction Matrix

	Phase	Landscape	Noise	Population & Human Health	Traffic	Soils & Geology	Hydrology	Climate Change	Cultural Heritage	Biodiversity – Flora & Fauna	Biodiversity - Avian Ecology	Material Assets	Electromagnetic Interference
Landscape	C												
	O												
Noise	C												
	O												
Population & Human Health	C												
	O												
Traffic	C												
	O												
Soils & Geology	C												
	O												
Hydrology	C												
	O												
Climate Change	C												
	O												

	Phase	Landscape	Noise	Population & Human Health	Traffic	Soils & Geology	Hydrology	Climate Change	Cultural Heritage	Biodiversity – Flora & Fauna	Biodiversity - Avian	Material	Electromagnetic Interference
Cultural Heritage	C												
	O												
Biodiversity- Flora & Fauna	C												
	O												
Biodiversity - Avian Ecology	C												
	O												
Material Assets	C												
	O												
Electromagnetic Interference	C												
	O												

Legend

– No Significant Interaction

- Positive Interacting Impact

– Negative Interacting Impact

- Neutral Interacting Impact

14.1 Impact Interactions

14.1.1 Landscape

The landscape impacts associated with wind farm on human beings is subjective. Some people dislike turbines, while others view them positively. For this reason, the interaction is shown as being neutral.

Archaeological features across a landscape can sometimes be connected by line of slight, with some significance attached to that connection; these features existing in an archaeological landscape rather than isolated individual features. In these circumstances, turbines could interrupt that connectivity. There has been no such connectivity established for the area around the site. As such a neutral interaction is assigned.

14.1.2 Noise

Noise is one of the aspects of the environment considered in terms of its impact on human beings. There will be increases in noise during both the construction and operational phases, which although within guideline values are considered a negative impact.

Noise during construction may deter wildlife from using the site. It has been found that during the operation of wind farms, when human activity / presence is very low, wildlife usage of the site returns to normal.

14.1.3 Population & Human Health

Human beings are discussed in terms of settlement pattern, public health, shadow flicker and recreation and amenity. These aspects of the discussion do not have any significant interaction with other aspects of the environment.

14.1.4 Traffic

There will be an increase in traffic for a short period of time during the construction phase, with insignificant traffic volumes during the operational phase. Additional HGV traffic during construction will have a temporary negative impact on the landscape, in terms of HGV movements; it will increase traffic noise on the roads leading to the site; it will increase dust and emissions associated with HGVs and therefore impact air quality; it will have a negative interaction (inconvenience) with local road users; and will temporarily displace wildlife using the site.

14.1.5 Soils, Geology & Hydrogeology

Rock will be imported to site from local quarries which will increase construction traffic and traffic noise. A neutral interaction is therefore assigned to noise and a positive interaction assigned to traffic.

The excavation of peat and soil will have a negative interaction with hydrology and climate. The excavation of soils may result in dust emissions, although the risk is slight due to the wet climate of the area. Dust emissions could impact on air quality. Erosion of excavated soils could impact on surface water quality. Excavated peat will decompose, releasing carbon into the atmosphere, a greenhouse gas, however the carbon payback will be achieved within a short period from commissioning.

The assessment concludes that there will be no impact on the groundwater flows or quality once the mitigation measures are implemented.

14.1.6 Surface Water / Hydrology

Incident rainfall could result in erosion of exposed soils impacting on water quality of the receiving streams and rivers. These impacts of the development on the surface water quality could impact on other users of surface water in the downstream catchment. Although no surface water users were identified, there may be unregistered abstraction points. In a similar way, it could impact on the aquatic habitats. So, for the construction phase, there is a potential negative interaction with soil & geology, ecology and human beings (as potential users of surface water downstream of the site).

14.1.7 Climate / Climate Change

There are no impacts envisaged on climate during the construction phase of the wind farm. The generation of electricity from clean renewable sources will have positive impacts on a number of other aspects of the environment, including:-

- Offsetting the production of greenhouses gases thereby slowing the rate of climate change and its negative impact on human beings.
- Climate change is predicted to result in more extreme weather events in Ireland, which will result in erosion of soils and more frequent and serve flooding events. Again, offsetting the production of greenhouse gases will have positive interactions for human beings, soils, hydrology and ecology.

Extreme weather events associated with climate change will affect the production of the wind farm. It is difficult to predict whether this will be positive or negative.

14.1.8 Cultural Heritage

No negative impacts are predicted for archaeology and cultural heritage. Hence, there are no interactions envisaged on the other aspects of the environment.

14.1.9 Ecology

The loss of habitat and removal of vegetation associated with construction of site infrastructure will have a knock-on negative impact on landscape. This will be at its worse during the construction stage. The landscaping of road verges will soften this impact, so a neutral interaction is assigned for the operational phase.

The removal of vegetation for infrastructure will also expose soils to erosion and will marginally increase runoff volumes to streams. Again, with the landscaping of road verges, these impacts will be mitigated, so a neutral interaction is assigned for the operational phase.

The loss of habitat and displacement of wildlife during the construction phase may have a negative knock-on effect for avian fauna using the site for either nesting or foraging. This negative interaction is not envisaged during the operational phase.

14.1.10 Avian Ecology

The impacts associated with avian fauna are not predicted to have any significant interaction with other aspects of the environment. The temporary displacement of raptors from the site during construction could increase the numbers of prey species, but for the short construction period, this is considered insignificant.

14.1.11 Material Assets

Impacts on material assets and their interaction occur during both the construction phase and operation phase. During construction, there will be an increase in traffic which will have a negative interaction with the roads, as considered a physical material asset.

The importation of stone from local quarries will reduce the aggregate resources at local quarries and so would be considered a negative aspect of the development; however, this is balanced against the sourcing of stone from an authorised quarry operating with environmental controls. The overall interactions are therefore neutral.

The alternative use of the land resource has a positive impact for the landowners involved during the operational phase of the wind farm.

14.1.12 Electromagnetic Interference

Electromagnetic interference is not expected to be an issue during the construction stage. During the operational phase, turbines could interfere with TV reception or other telecommunications, although this would be rectified by the developer if it occurs. A negative interaction is therefore assigned for human beings and material assets.

14.2 Conclusions on the Interaction of the Foregoing

The interactions of all environmental factors indicate an overall positive development capable of providing a clean, renewable and sustainable energy source for the region. The main impacts have been discussed in the preceding chapters and appropriate remedial measures are presented where necessary. The construction of the wind farm will have no significant additional impact on the environment over those predicted for the permitted wind farm at Graffy, which this development would replace if granted planning permission. The overall conclusion of this EIAR is that the site is suitable for the proposed development and that the use of a larger turbine (over that permitted) will provide greater benefits in terms of maximising the energy yield of the site.